The Empire Cotton Growing Review

Journal of the Empire Cotton Growing Corporation

Vol. XXV. No. 1

January 1948

19/4/48

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Published on behalf of

The Empire Cotton Growing Corporation

by Staples Press Ltd., 14, Great Smith St., London, S.W.1

PRICE: 1s. 8d. post free.

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THE EMPIRE COTTON GROWING REVIEW

VOL. XXV. JANUARY, 1948 No. 1

THE EXPANSION OF EAST AFRICAN COTTON PRODUCTION

IN the April number of this Review we discussed, with reference to the need for reducing imports from the United States, the prospects of increased cotton production in the Empire, and made some suggestions as to policies and methods which might be effective to this end in the East African dependencies. We recognized that any such suggestions would require to be examined in the light of local circumstances by the people on the spot, and invited comment.

As a result we have since published a series of six articles from officers of the Empire Cotton Growing Corporation in the East African area. Three of these contributors are in a position to survey the whole field, three to discuss the position in their respective territories—the Sudan, Tanganyika, and Nyasaland. Each is intimately acquainted with the factors involved in present production, and qualified to discuss its extension with authority.

The considerations brought forward in this discussion, supplemented in the present issue by the article from Sir Edmund Teale on geology, soils and climate, demonstrate the extreme complexity of the circumstances which must be taken into account by schemes of African development. A politician paints with sweeping brush a picture of Africa made " to blossom like the rose." A highly responsible minister declares to the African Governors his only hope for the salvation of the sterling area in terms reminiscent of Canning's phrase, " I called the New World into existence to redress the balance of the Old."

The fact must be faced that Africa is no New World, but for the most part an old and tired continent, save in the limited areas where " recent " volcanic activity has renewed the soil. Nor are the inhabitants of its tropical zones Red Indians who can be pushed aside, but must be recognized as the permanent occupants of their country. The African farmer, with all his present limitations, must in large measure provide the human factor in the development of his country's industries.

Our contributors are agreed that substantial increases are capable of attainment from the areas already occupied in the production of

cotton, but make it clear that this depends on closer organization and involves the acceptance by the native farmer of direction and supervision. This conclusion, in varying terms, is forcibly expressed:

> "At present, when African peasant practices are sometimes regarded as sacrosanct, or at best immutable, little can be done along any of these lines. A situation in which, in return for assistance in the way of water supplies, mechanical cultivation, and possibly some communally organized labour, the African relinquishes some freedom of action to plant what and when he likes, would make it possible to put these measures [for pest control] into practice." —*E. O. Pearson.*
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> "It is with the greatest difficulty that the cultivator can be persuaded to improve his methods. Simple propaganda is largely ineffective. . . . A very large potential increase in the production of all crops—probably as much as 100 per cent. for cotton in many areas—awaits the adoption of better methods in farming practice." —*F. R. Parnell.*
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> "There is a large measure of agreement among those best able to judge that an agricultural revolution is necessary in every densely populated area in East Africa, if the existing standards of life are to be maintained in the face of rising population and falling soil fertility. . . . The basic need is to plan the use of the land, and to enforce the execution of the plan through an adequate technical staff, armed with full authority and the support of the administration." —*J. B. Hutchinson.*
>
> "If it were worth while the crop [in Tanganyika] might be doubled or even trebled. But the project would have to be approached in earnest. *European guiding staff would be essential.*"—*J. E. Peat.*
>
> "A planned economy for the [Nyasaland] cotton areas is much to be desired. . . ."—*H. C. Ducker.*

That a similar situation has led to the same conclusion in parts, at least, of the Belgian Congo, is illustrated by the account of a resettlement system reviewed later in this issue. In this most interesting experiment the native has accepted direction in return for access to new land under conditions which should ensure a permanence previously lacking, maintain a steady level of nutrition, and provide a foundation for social progress.

The British farmer has had to accept direction in the interests of State economy; there should be no great objection to persuading the African to accept it in his own, provided that it does not, as it need not, conflict with his social organization. By what body this direction should be exercised is a question for consideration; the organization of the Sudan Plantations Syndicate has been quoted as an example, without necessarily implying that this body should be taken as a pattern.

The establishment of planned and directed use of land, and the existence of the organizing and supervisory staff which this implies, would open the way to wide measures of co-operation in the preparation

for crops, their cultivation and protection, and their disposal. There is no other means by which native agriculture in the occupied areas can advance from its present primitive condition; there is none by which new settlements can have their permanence assured. In many areas no hope is possible that simple persuasion will overtake the rate of deterioration.

It will be noted that fully mechanized cotton production, which might seem to offer a solution independent of native economy, is not at present taken into serious account by instructed opinion. One difficulty is obvious, apart from questions of heavy capital costs and the availability of machinery. The operation which alone frees the system from dependence on a large labour supply—harvesting—depends for its success on a highly specialized type of cotton plant. To breed such a type, or to adjust an imported type to African conditions, would at best take many years of intensive work.

Apart from Nyasaland, where there is active competition between cotton and other cash crops, no particular emphasis is given to the question of price. It is obvious that if the basic requirements for more intensive production as outlined should be adopted, the overall cost of cotton growing would be substantially increased and would absorb all or most of the present difference between the market value and the price the grower receives. What becomes of this margin at present is not too clear, but it is doubtful if it serves so appropriate a purpose.

Given the possibility of increased production, the next question is that of the type and quality of the product. Sound reasons are given why the present superior types should not, and indeed cannot, be readily displaced. A recent meeting with spinners in Manchester, at which this matter was discussed, left an impression—the diversity of requirements among those present did not lend itself to a more definite conclusion—that if grading and description were made more reliable, these types could find a market in Lancashire. There would remain, however, the much wider demand for types comparable with ordinary American such as have been received with favour during the War from the Belgian Congo. These must be produced in quantity if the object which prompted this discussion, the reduction of dollar purchases, is to be attained. The substitution of shorter and more robust types might be found profitable in some of the less favoured areas, but as matters stand in East Africa the main sources of any such supply must be looked for from the extension of settlement into newly opened country. There is a prospect that West rather than East African possibilities may be developed to meet the situation.

THE POSSIBILITIES OF INCREASED PRODUCTION OF COTTON IN NIGERIA

BY

J. R. MACKIE, C.M.G.

Late Director of Agriculture, Nigeria

NIGERIA'S contribution to the world's supply of raw cotton is still comparatively small, being on the average between 30,000 and 50,000 bales. It has however been as high as 73,000 bales, and as recently as the 1944-45 season fell to the low figure of 15,000 bales. The crop is produced entirely by small peasant farmers—large-scale estate production has never been attempted in Nigeria—so that in examining the possibility of increased production it would obviously be sound to consider whether this peasant production is capable of further expansion before going on to any question of developing large estates on the East African groundnut model. As Nigeria has a population of some 20,000,000 people a very small increase per farmer would result in a very large increase in the total cotton output, and this increase could be obtained without vast capital expenditure, or the provision of large quantities of special equipment. Moreover, past experience has shown that increases in peasant production in Nigeria can, given the necessary incentives, be extremely rapid. For example, the Nigerian cotton crop increased from 24,000 bales in 1938-39, to 50,000 bales in 1939-40, and to 73,000 bales in 1940-41. Similarly, groundnut production rose from 22,000 tons in 1923, to 78,000 the following year, and 127,000 tons in 1925. It is extremely doubtful if any other means could produce results with more rapidity. The spectacular nature of the East African groundnut scheme, and the large sums of money involved, seems to have caused both the possibilities of expanding production by the African peasant and the steady work of the Agricultural Departments to be somewhat overlooked. The fact that Agricultural Departments are losing experienced and trained staff far more quickly than replacements are coming forward has received very little attention, yet, as will be shown later in this article, increased production of cotton depends very much on a concentrated effort being made by the Agricultural Department.

Cotton is grown throughout the whole of Nigeria except on the acid sands of the Eastern Provinces, and long before there was any question of an export trade in cotton the indigenous types were cultivated to provide the raw material for the local spinning and weaving industry. There is a weaver in almost every village, but in addition there are

centres, such as Kano and Iseyin, which have always had a reputation for their cotton cloth, and where weaving has become quite a highly organized industry. This internal trade has always absorbed a very high proportion of all the cotton produced in Nigeria, and the quantity available for export is merely the surplus which is left after the requirements of the local industry have been met. In recent years, owing to the dearth of imported cloth and its high cost, there has been a considerable increase in the demand for locally made cloth, and this has had its effect on the quantity of cotton available for export.

This internal demand for cotton is a most important factor in the production of the crop in Nigeria. As long as it exists cotton will always be grown; and even if the surplus available for export falls to a very low level—as it has often done in the past—production can always be expanded again quite rapidly. Further, it has an important bearing on the types of cotton which are cultivated, for if a variety is to be successful it must be suitable for both the requirements of the local industry and for the European market. It also governs the price which must be offered if cotton is to be attracted to the export markets. The local demand will always be met first and the export trade has to compete with it. This is shown by the fact that in the early part of almost every buying season the price of cotton in the local markets is invariably higher than that offered by the exporting firms in the gazetted markets.

The success of Allen's Longstaple, the type grown in Northern Nigeria, is to a considerable extent due to the fact that it meets both requirements. It is acceptable to the local weaving industry, and although from Lancashire's point of view it is not a perfect cotton, it has always found a ready market and has consistently fetched a substantial premium over American Middling. This premium was a very important factor in keeping the export trade going during the period of very low prices which existed for a few years previous to the last war.

Allen has also proved to be a satisfactory type from the agricultural point of view, and although it has been tested against dozens of other varieties it has always held its own, and can be relied upon to yield fairly consistently year after year. The commercial crop consists of a mixture of strains, and many selections have in the past been made and tested, but of these only No. 26C has proved to be a very definite improvement. This selection, which is characterized by both a high yield and a high ginning percentage (37%), is now being multiplied for general distribution. Although it may be possible in the future to breed, or to introduce, a variety which would be an improvement from the point of view of the Lancashire market, it is clear that any immediate expansion of production in northern Nigeria will have to be based on Allen.

One of the main essentials for a rapid increase in the production is an

assured supply of seed of a variety which is suitable for a very wide area. As far as Northern Nigeria is concerned this requirement can be met, for it is an interesting fact that Allen is a successful type for all parts of Nigeria where guinea corn is the staple food crop—*i.e.*, approximately as far south as the line of Lat. 9 degrees N. South of this line, where the yam becomes the staple food crop, Allen has not been a success, and in the extreme north where the wet season is too short for guinea corn to be depended upon, and millet becomes the chief food crop, the season is also too short for Allen cotton. This, however, is quite a narrow belt, and for all practical purposes Nigeria can be roughly divided into the guinea corn belt and the yam belt. In the guinea corn belt, given a jassid resistant variety, neither insect pests nor disease are usually serious limiting factors; but in the yam belt both are apt to cause serious damage.

In view of the above it is perhaps a little surprising that the growing of cotton as an export crop is confined to such a comparatively small part of the guinea corn belt. Practically the whole of the present crop comes from southern Katsina, part of the Zaria Province, and eastern Sokoto. There was formerly a small but very steady output from the Abuja area of the Niger Province, but this has now almost ceased, and the small ginnery which the B.C.G.A. maintained at Abuja town has been closed down. There has, however, recently been a very satisfactory increase in production in the Kontagora area, and the ginnery formerly at Moriki has now been moved to Kontagora town. This is a particularly pleasing development because it has taken place during a period when all the emphasis was on groundnuts and cotton was actually discouraged.

As with any other crop, the quantity of cotton produced depends upon the acreage planted and the yield per acre, but in the case of cotton, as has already been shown, the internal market will also affect the quantity available for export. Little or no increase in the acreage under cotton can be expected in southern Katsina and the main cotton-growing area of Zaria. This area has more or less reached saturation point, and any increase in acreage unaccompanied by improved agricultural methods would almost certainly result in soil erosion and a deterioration of soil fertility. Any increase in production from this area must come from an improvement in the yield per acre. There are, however, vast areas within the guinea corn belt the possibilities of which have never yet been seriously tested. This applies to the pagan areas of southern Zaria and the Niger Province, the Southern Division of the Plateau Province, almost the whole of the Bauchi Province, much of northern Adamawa and southern Bornu. It is perhaps worth noting that much of this untested area is inhabited by rather primitive pagan tribes, and that on the whole the conditions are more suited

to cotton than to groundnuts. Indeed some of the pagans have a taboo against groundnuts and would not grow them in any case; but most of them do cultivate some cotton, and excellent crops of the indigenous type are grown in Bauchi, Adamawa and the Biu Division of Bornu.

In normal times cotton and groundnuts are not serious competitors. Cotton will grow wherever guinea corn will grow whether the soil is heavy or light, but groundnuts do best on light easy-working soils. Groundnuts are therefore normally grown on the light soils and cotton on the heavier types, and the farmer knows quite well which pieces of land are best suited to each crop. There is therefore no definite groundnut belt and quite a large acreage of cotton is usually grown in Kano and northern Katsina mainly on the heavier patches of soil. But cotton also takes the place of groundnuts if seed supplies are short or the early rains are poor, for even in Kano cotton can be planted later than groundnuts and will still produce a crop. Past experience shows that the best groundnut seasons are also good cotton seasons and it is possible to have maximum production of both in one year. Thus the season 1936-37, which saw the biggest groundnut crop ever produced in Nigeria, also produced 47,500 bales of cotton, which was well above the average. Similarly, the season 1940-41, another big groundnut year, was also Nigeria's record year for cotton. The attempt made by the Administration to create a definite groundnut belt inside which cotton for export would not be grown was, therefore, obviously unsound. While it did not materially increase the quantity of groundnuts produced it did result in considerably less cotton becoming available for export, chiefly because the local weaving industry, being unable to obtain its usual supplies from Kano and northern Katsina, increased its demands on southern Katsina and Zaria. It can therefore be taken for granted that in Northern Nigeria there could be a considerable increase in the acreage under cotton without in any way interfering with the quantity of groundnuts produced.

Cotton always has to take second place to food crops. These are planted, and are usually well established, before any work is done on cotton, and the weeding and thinning of cotton are often so delayed that the plants suffer a severe check. The very low yields obtained from a high percentage of native farms are usually due to this delay in both planting and weeding, but experiments have shown that a considerable increase in yield can be obtained if the young cotton is thinned to two or three plants per stand at the right time, even if labour cannot be spared for weeding. Increased yields would also be obtained by closer spacing, but these are comparatively small matters compared with the increases which will be obtained when the mixed farming systems advocated by the Agricultural Department are widely practised, for

they involve both the use of the plough and the conservation and use of manures. Mixed farming is now making steady headway, but it can hardly be counted upon to produce the quick results which the present emergency demands.

There is no doubt whatever that a big increase in cotton production by ordinary native methods is possible in Northern Nigeria. It could probably be at least doubled in quite a short period of time. What are the essential steps which must be taken in order to achieve this result?

First of all there is of course the question of providing more and suitable consumer goods in order to provide the incentive for increased effort, but this presumably is already receiving attention at the highest level, and cannot be discussed in this article. Apart from this, the first and most important step to be taken is to give the Agricultural Department enough trained men to enable it effectively to cover the whole of the Northern Provinces. It is no mere accident that the production of cotton for export has spread outwards from the Agricultural Department's headquarters at Zaria, or that it has developed in those areas which have been adequately staffed by the Department. The present cotton industry is one of its real achievements. The Department has been greatly assisted by the B.C.G.A., which has always co-operated in every possible way, but past attempts by the latter, and by the Administration to develop production in areas where the Agricultural Department has not been able to assist have been failures. The mere provision of ginneries is not enough. There was a ginnery at Ibi on the Benue for years, but in the absence of agricultural staff working in the area served by it there was no development of cotton production. It cannot be too strongly emphasized that the expansion of the cotton industry requires a concentrated effort by the Agricultural Department. In addition to the provision of ginnery facilities, the transport and distribution of seed must be organized, markets for grading provided and supervised, the strain must be kept pure, and the farmers must be taught how to grow the crop to best advantage. This is especially important in new areas where a change is being made from indigenous cottons grown as perennials to one which is grown as an annual. Previous to 1939 there was only one Agricultural Officer and one small experimental station east of the Plateau, the Agricultural Department being quite unable to provide staff for either the Bornu or Adamawa Provinces. At present the position with regard to agricultural staff is deteriorating rapidly—no less than twenty trained officers have left since the beginning of 1945—but if cotton is really wanted this state of affairs must be arrested and the Department built up to full strength as rapidly as possible. It can be done, and more cotton can be produced if the situation is considered to be sufficiently serious to justify unusual and drastic means.

The other essential for increased production is a price to the producer

EMPIRE COTTON GROWING CORPORATION

"The Empire Cotton Growing Review" is the official organ of the Empire Cotton Growing Corporation. It is published quarterly (in January, April, July, and October) and contains original articles, reviews, and notes on scientific, commercial, and technical literature. Contributions from authors on subjects bearing on the work of the Corporation will be welcomed by the Editor.

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which will enable the export trade to compete with the local industry, thus encouraging the producer to produce a surplus for export. Between the wars the price of cotton fell to very low levels, and in areas remote from the railway where the price offered was several tenths of a penny less than the railhead price it did not pay the farmer to grow more cotton than would just meet the requirements of the local weaving industry. With a price of, say, six-tenths of a penny per lb. for seed cotton at Zaria, there was little or nothing left for the producer at places remote from the railway such as Bauchi, Bornu or Adamawa. The cost of transport has always been the main factor which has hindered the development of the produce trade east of the Plateau, and although the southern part of the area is served by water transport on the Benue and its tributaries, prices at river stations were notoriously low and the producer did not receive the full advantage of what should be a comparatively cheap form of transport.

One of the most important features of the campaign for increasing the production of groundnuts was the introduction of flat prices over very wide areas, which gave the producers in remote areas the same price as those near the railway. Re-examination of the firm's schedules also resulted in much higher prices being paid at river stations. If similar arrangements were applied in the case of cotton there would be a real incentive to the producer to grow more cotton for sale to the exporters.

Large-scale operations on estates under European management have never been attempted in Nigeria, but if this method is to be tried, Northern Nigeria would certainly appear to offer many advantages. A suitable type of cotton has already been established, and adequate supplies of seed are available; there are vast areas of thinly populated or unoccupied land, and it should always be possible to attract sufficient labour for operations such as picking which would have to be done by hand, while insect pests and disease are not limiting factors as they are in other parts of Africa. Against these advantages must be put the fact that the yield on average land is not high, but experiments have shown that this is largely a question of manuring. The whole problem of the maintenance of soil fertility still requires a great deal of research, especially as the use of tractors will necessitate the removal of the stumps of all trees and woody shrubs, and experimental work on the establishment of grass leys is still in the initial stages. But a good deal can be learnt from experience in Southern Rhodesia, where a combination of green manures and artificials in conjunction with modern methods of soil conservation appears to be giving encouraging results.

The problems involved in increasing the production of cotton in the yam belt are much more difficult than in the guinea corn belt for it will first of all be necessary to find a suitable type of cotton. As the belt

covers a very wide range of conditions it is probable that no one type will be suitable for the whole area. In any case the breeding of a new type or the testing of introduced varieties will take time, so that quick results are hardly likely to be achieved.

Present production is confined to the Ishan crop, which varies between 3,000 and 6,000 bales, and a small output from the Benue area which is ginned at Lokoja. The Ishan crop comes from the Abeokuta and Oyo Provinces, where it is grown as a catch crop often interplanted with yams. Cotton growing has a long history in this area for it was at Ibadan that the B.C.G.A. many years ago made an abortive attempt to grow cotton on an estate scale. The attempt having failed the estate became, and still is, the headquarters of the Agricultural Department. The original cotton of this area was a short, coarse type usually known as Meko cotton. Attempts to supersede this type with Allen having failed in spite of much administrative pressure to make the farmers grow it, selected Ishan was introduced, but the old Meko cotton still survives and a considerable amount of care is required to ensure the purity of the Ishan crop. Ishan is a very unusual type of cotton and, although it has always found a market and receives a substantial premium over American Middling, it is not really liked either by Lancashire or by the local weaving industry. Attempts to improve it by crossing with Sea Island and other introduced varieties have not been successful, neither has it been successful in the drier parts of the yam belt—*e.g.*, Ilorin and the Benue area. It is a cotton for the wetter areas where cocoa and oil palms flourish, and it will not be easy to find a new variety for such conditions as insect pests and disease are both prevalent. *Helopeltis* is a very serious pest and in some seasons almost completely destroys the crop at Moor Plantation, while *Bacterium malvacearum* causes serious damage in very wet years.

It is unlikely that any great increase in production is to be expected from this Abeokuta-Oyo area, as it is also a very important food-producing district. But in any case it is doubtful if any great increase in Ishan cotton is really required as it can be used only for special purposes. Several attempts have been made in the past to develop cotton production in the Ilorin Province, but they have not been very successful because in this area cotton cannot compete with food crops, for which there is a steadily increasing demand in the heavily populated and relatively wealthy areas further south.

It is in the Benue basin that the possibilities for greatly increased production exist, and where much investigation is still required. There has always been a small export of cotton from both the Wase area and from eastern Kabba, but little has so far been done to encourage it, and the closing of the ginnery at Ibi has increased the difficulties of seed distribution, as seed now has to be sent from Lokoja. Until

recently, when an Agricultural Officer was posted to Yola, there was only one agricultural station for the whole of the Benue area and it was quite impossible for the Agricultural Officer stationed there to cover the whole district, or to concentrate his efforts on the production of cotton.

Between 1926 and 1929 both the Agricultural Department and the B.C.G.A. made a serious attempt to promote cotton production among the Tiv people as an alternative crop to beniseed, but the attempt ended in failure. The Tiv rightly preferred to stick to beniseed, which gave them a better return than cotton and was extremely well suited to their system of agriculture. It should be observed, however, that the variety tried was Allen, and Allen has never been successful in the yam belt. A few selections were made from the indigenous Kabba types but as no plant breeder was available to concentrate on the problem little progress was made. The Kabba types do, however, offer scope to the plant breeder as they show considerable variation. There are among them still traces of types such as Black Rattler, which were introduced to the area as long ago as 1912, when for a short time an Agricultural Station existed at Ankpa. This station was closed in 1914, and since then nothing further in the matter of introductions has been done.

In the Adamawa Province excellent crops of indigenous cotton are grown especially in the Jalingo area, and it is here that the prospects of increased production are most hopeful. But it will require a concentrated effort by the Agricultural Department, and investigations by a plant breeder are a necessary preliminary. Very little is known about the incidence of pests and disease or of yield in this area, so that it is impossible to say at this stage whether it would be suitable for experiments in estate production.

If production in Nigeria is to be developed to its maximum extent the first requirement is a consistent production policy. Too much effort has been wasted in the past in attempting to force the people to grow the crop for which there happens to be a demand, in areas which are quite unsuited for it, often in disregard of the advice of the Agricultural Department. This happened in the groundnut campaign, and will almost certainly happen again unless a definite policy based on all the facts which are available is laid down and adhered to.

Received November, 1947.

UNDEVELOPED LAND IN EAST AFRICA, WITH SPECIAL REFERENCE TO TANGANYIKA

BY

SIR EDMUND TEALE, D.Sc., F.G.S., F.R.G.S., M.Inst.M.M.

AFRICA is a land of contrasts. Thus, while there are certain over-populated regions with over-grazed and worn-out or eroded soils, there are still vast areas of virgin land. It is only natural, therefore, that attention should be directed to making use of these undeveloped lands for the welfare of the local inhabitants and for their contribution to the urgent world demand for food and other raw materials.

The launching of the Groundnut Project in East Africa in particular, together with other development plans, such as have been envisaged by Dr. Worthington for Uganda, have focused public attention on the expected speeding-up of African development. The Groundnut Project, especially, has caught the imagination of the general public and raised hopes of almost unlimited expansion in this and other types of agricultural production from the vast unoccupied and little used spaces of East Africa and perhaps many other parts of Tropical Africa as a whole.

This emptiness of Africa has forcibly struck many who have travelled through parts of it by car or rail or, more recently, have flown over it. It has been calculated by Clement Gillman in the preparation of his population map of Tanganyika that two-thirds of the population are concentrated on one-tenth of the area of the land. It is not surprising, therefore, that the idea should have developed that there awaits here the opportunity for easy occupation and development.

Those who have journeyed the seven hundred and fifty miles across Tanganyika along the Central Railway can hardly have failed to wonder why, with ready transport available, such vast spaces of bush-covered land should have remained for so many years unused either by Europeans or natives. Many factors have contributed to this emptiness here and elsewhere in the past, these include epidemics, famine, tribal wars and slave raids, etc. Though most of these have either gone or have been partly overcome, other factors still remain which hinder occupation or development. The most important of all is the lack of a reliable water supply in many regions.

To many unacquainted with the local conditions, to judge from optimistic opinions expressed in Parliament or in the daily press, it is clear

that these tropical regions are regarded essentially as potential sources of easily tapped products, either of food or raw material, for a hungry or depleted world. The problem is, however, not as simple as it looks. Recently an important debate took place in the House of Commons on the Overseas Resources Bill, by which the Government proposes to give effect to the proposals for establishing a Colonial Development and Overseas Food Corporation with borrowing powers of £165,000,000. One of the main objects will be the establishment of new projects on virgin soil rather than the development of existing industries. About the same time Sir Stafford Cripps, as Minister of Economic Affairs, addressing the African Governors' Conference in London, said: " The whole future of the sterling group and its ability to survive depends, in my view, on a quick and extensive development of our African resources. I believe that in your hands lies the ultimate solution of our present difficulties." The urgency of the situation is no doubt very real, but the fact that a *quick* result should be demanded indicates the all too prevalent view that the empty spaces of Africa can give quick and easy returns even with the most extensive mass efforts assisted by modern large-scale mechanization. Speeding-up, however desirable, has its limits in primitive Africa. It is here that one who has been in close contact for many years with the empty spaces of East Africa and their potentialities feels constrained to emphasize strongly that among the many factors, natural and economic, which are involved, two major considerations are basic and paramount: (1) The investigation and development of the water supply; (2) the survey of the soil potentialities and the ensuring of the fullest measures, not only for its conservation, but the improvement and maintenance of its fertility.

Anyone who has studied in detail the plans and organization of the Groundnut Project will have realized that the promoters had no illusions regarding the problems and difficulties to be tackled and overcome in developing new lands in East Africa. Scientific research is being given a large measure of attention, and as full a team of scientific and technical workers as is possible under the existing shortages has been engaged to investigate and cope with the diverse obstacles that are apparent or may be expected. One of the unfortunate drawbacks has been the necessitated small time limit for the initial preparations and detailed regional survey. No doubt such success as the circumstances permit will be attained in the end, but in many respects experience will have to take the place of foresight, always a wasteful method. This example, therefore, should be a salutary warning to promoters of other similar projects that comprehensive and systematic survey of all the factors by the best experts available is absolutely necessary for the ultimate success of any new large-scale venture in these regions. Undue hurry which ignores the awaiting of the results of

such investigations is simply asking for trouble. The contemplation of further large schemes for development should also take into account the shortage of trained scientists and technicians which cannot be overcome for several years at least.

Notwithstanding the valuable research of many devoted and capable scientific officers of the Agricultural, Veterinary, Forestry, Geological, Tsetse Research, and Medical Departments, including the East African Agricultural Research Station at Amani, in the course of a number of years, it must be admitted how little is yet known about the natural resources and potentialities of large areas in the country. Lack of adequate funds and consequently of trained staff partly accounts for many of the deficiencies in our knowledge, but it must be emphasized that even under more favourable abundance of scientific investigators, many of the vital problems would still have needed long-continued research and survey to provide the necessary data for sound development.

East Africa lost a valuable and capable investigator with the death of the Amani Soil Officer, G. Milne, who made the first attempt to compile a soil map of Tanganyika. It was an inspiring beginning, but it needs to be followed up by more detailed survey of special areas on larger scale maps. Now that more ample and generous financial assistance is available from the Colonial Development and Welfare Fund for many of these overdue investigations, it is most unfortunate that the supply of trained scientists is not sufficient for the tasks, owing to the dislocation of training due to the second World War. There must, therefore, be further unavoidable delays in the carrying out of the many urgent investigations that are waiting.

Without attempting to analyse all the many factors involved in the cause and remedy of the large undeveloped spaces in East Africa, or Tanganyika in particular, there are several basic considerations concerning the natural features, the dictates of which cannot be ignored. These include the intimate interaction of geological and other natural features with the climatic conditions. The result of this determines mainly the fertility of a region, and its agricultural possibilities. For example, the special rock formation, which in combination with the favourable climate and adequate rainfall results in the fertile volcanic soils of Kilimanjaro or the highlands of Kenya, provides only a barren, stony desert in some of the more arid regions of the country. The geology or the climate apart, or even together, may not provide a safe criterion regarding the agricultural possibilities of a given area, for both may be offset by unfavourable physical features such as are found in some of the Rift valleys or inland dischargeless basins. In East Africa in particular these can often have a dominating effect.

Let us now follow up these general remarks with more detailed consideration of the more salient of these basic factors and their interaction.

Geology.—It is generally well recognized that the soil is formed by slow complex chemical and biological reactions on the rocks of the earth's crust, and that the nature of the rocks has an important influence on the character of the overlying soil, excluding, of course, the transported soils such as alluvium. Thus, in general a particular kind of rock, be it a volcanic type, a granite, a limestone, or a sandstone, etc., can be expected to yield a definite class of soil, and given a knowledge of the climatic and topographic conditions much can be forecast regarding the agricultural conditions and possibilities. A careful and detailed geological mapping is therefore an important requisite as a foundation for a systematic soil survey. Though the broad general geological structure of East Africa is approximately known, very little detailed investigation has yet been possible to meet the needs of a detailed soil survey. It is nevertheless possible to review broadly some of the salient aspects of this problem. We will consider Tanganyika here, for this is where most attention is being directed at present, to the empty spaces, and where the first of the Groundnut Projects is being developed. For present purposes we can simplify the grouping of geological formations into five major groups: (1) The Basement Complex of crystalline gneisses and schists; (2) The Granites; (3) The Volcanic Rocks; (4) The Sedimentary Formations; (5) Alluvial and swamp formations.

1. *The Basement Complex* comprises a variety of most ancient crystalline rocks, the most important of which are gneisses and schists; the former approach granites in composition but are banded in structure and the formation as a whole has a stratiform character, in contrast to the more massive and jointed character of the granites. This is of importance both regarding the soil and the underground water supply. Boring operations so far conducted indicate a somewhat higher percentage of success with a better yield of water at a shallower depth than that obtained from typical granites. This formation covers approximately 45 per cent. of the total area of the country, and embraces a very large proportion of the unoccupied or thinly populated regions. The soils derived from these rocks are fairly uniform in character, but only of medium fertility, except in the very limited regions of high rainfall as in portions of the Usambara Mountains. In many of the wide old peneplain regions the soil would appear to be mature and probably leached of some important mineral constituents, especially the available phosphate content.

2. *The Granites.*—Rocks of this character cover a large area, next in importance to the Basement Complex, comprising about 27 per cent. of the total area. They are found chiefly in the central plateau from the vicinity of Dodoma to beyond Tabora, and extending north to Lake Victoria. The soils are generally of a uniform character, but

climate and topography have a marked influence locally. Though the soils are generally poor, the area supports in many places undesirable concentrations of native populations and cattle, to the serious detriment of the soil. This region is of little importance from consideration of available undeveloped lands. It is rather to be regarded as a source of potential pressure towards the undeveloped regions.

3. *The Volcanic Rocks.*—These are of two ages. The latest or Tertiary volcanic rocks, which provide the richest soils in the highlands of Kenya and in Tanganyika, are best developed in the Northern Province round Arusha, Moshi and the Giant Crater region, also to a more limited extent in the south-west highlands in the vicinity of Tukuyu and Mbeya. The percentage of total area amounts to about 2½ per cent., but only a fraction of this is represented by rich arable soil, owing mainly to adverse conditions of climate and to a lesser extent to topography. Another area of volcanic rocks of much greater age is found on a portion of the Kasulo highlands, representing perhaps 0·2 per cent. of the total area. Climatic conditions favour this region, but certain topographic and other factors imperil its fertility through dangerous soil erosion. It can be safely said that little of the volcanic areas is available for further settlement. The main problem is the conservation or rehabilitation of what is now occupied.

4. *The Sedimentary Formations* can be roughly divided into two major groups: (*a*) The old formations ranging from Karroo (Late Palæozoic to Pre-Cambrian) are found chiefly in high blocks of the interior, mainly in the west. (*b*) The younger group, from Jurassic through Tertiary to recent, forms a coastal strip ranging from less than twenty miles wide near Tanga in the north, to over sixty miles in the south near Lindi. Parts of the old sedimentary formations in the west, especially south of the Central Railway, extending south mainly for about fifty miles and of about the same width, and much farther along a narrower belt, consist of sandstones and some shales. They give rise to poor sandy soils as a whole. This area is not of much promise from an agricultural point of view. Smaller patches of Karroo sandstones and shales in the south-western highlands, the most important in the Ruhaha valley, east of Lake Nyasa, are characterized by poor and shallow soils. Similarly a much larger area of these rocks in the inland portion of the Southern Province is, as far as known, characterized by coarse and poor sandy soils. The zone of coastal sediments is on the whole more favoured by its geographical position and somewhat better rainfall than much of the interior, though its soils are generally of a light character. It is not known how much, if any, of the large groundnut area in the hinterland of Lindi includes soils of these formations, but generally there can be little of this belt that is available for new development.

5. *The Alluvial Plains and Swamp Lands including "Mbugas."* These are areas of moderate extent embraced under these headings, and they include a considerable percentage of undeveloped land, but there are many difficult and complex investigations necessary before their agricultural development can be assured. The problems vary from place to place. Among the important swamp lands of some extent are those of the Kilombero valley, the Malagarasi, and the Wembere, and smaller but still important areas in the Bukola district and along portions of the Kagera river in Karagwe. There are the scarp-foot alluvial and colluvial soils of part of the Mkata and their extension northerly between the Wami and the scarp-foot of the west. Those of the more arid Bahi area at the foot of the Kilimatinde scarp and again farther north as far as the Mbulu scarp at Mbugwe involve conditions much less promising for easy development. The "Mbugas" or seasonal swamps form a class by themselves, often occupying considerable areas, chiefly in the more arid regions of the old peneplain surfaces. They are characterized typically by a stiff black clay which becomes hard and cracked when sun-baked in the dry season, and almost impassable to man or beast when wet. In some of the more favoured areas they may afford seasonal grazing for cattle, and their impervious soil has favoured the excavation of tanks, or "hafirs," for seasonal storage of water for cattle. The utilization of the soil has usually been avoided by the natives, but it has been shown that many have some agricultural possibilities under skilled management.

In summing up briefly from this general geological review it appears that the most likely areas of undeveloped country with certain potential possibilities are situated in parts of the central plateau south of the Central Railway, where the soils are derived from the old Basement Complex, and in certain areas of the hinterland of the coastal belt.

Climate.—Some brief references have already been made to the effect of climate, favourable or otherwise, on soil and agricultural development. Only a few brief observations can be added here. The climate of East Africa as a whole shows very considerable diversity owing largely to topographical considerations including altitude and disposition of plateau blocks. There are many very striking contrasts within very short distances owing to the very special topographical plan. It is only natural to find that the most favoured regions climatically are already fully occupied, and in some cases already exerting a pressure on the adjoining less favoured regions. Over great portions of the country the climate is characterized by considerable unreliability of rainfall. The extremes, especially of drought, over wide areas introduce much uncertainty for agricultural purposes, and this is most severely felt in sub-arid regions which have little margin of safety for crop raising, generally in areas of less than an average of

thirty inches of rainfall per annum. The areas more favoured by rainfall represent a relatively small percentage of the total area. These include the vicinity of the major lakes of Nyasa, Tanganyika, and Victoria, the isolated mountain masses of the Usambaras, Uluguru, Kilimanjaro, Meru, the south-western highlands, and much of the coastal belt. Elsewhere long dry seasons with drying winds and hot sun cause a very high evaporation which seriously affects agriculture and open surface water conservation in reservoirs. It is the distribution of the rainfall during the year and the character of its incidence which is often so unfavourable and so vitally important. Thus there are large areas with a rainfall comparable in amount with that of London, but which may have a rainless season lasting for six months, resulting in almost desert conditions for part of each year. Meteorological data are sadly wanting in the undeveloped regions, and information regarding rainfall reliability is not available for consideration of development. A certain amount of general indication can be obtained from the study of the natural vegetation by a trained observer, but it is not adequate for detailed and reliable planning. Mainly from such considerations it would be expected that over most of the area of undeveloped country outlined previously the average but seasonal rainfall would be between thirty and thirty-five inches. This would indicate to the experienced local agriculturist the type of food crop most likely to succeed. At the best it would impose considerable limitations.

Topographical Features.—These features are mainly the result of the long-continued interaction of strong tectonic forces and erosive agencies, with, in addition, that of volcanic action in some regions. The outcome is the landscape with its soil as we see it today, which in many areas has a striking and far-reaching effect on the climate and thus on the agricultural possibilities. In a few instances it is highly favourable, but in many other regions adverse conditions are introduced. The powerful tectonic forces which have uplifted and fractured the coast of East Africa are associated with the well-known rift formations. Thus in Tanganyika in particular, the highlands are largely broken up with a series of usually dissected plateau blocks of varying altitude, often separated by sunken areas in some of which are large fresh-water lakes, but elsewhere there are shallow saline lakes such as Eyasi, Natron, Manyara, and others; or the depression may be traversed by a river, as in the case of the Upper Ruaha. Elsewhere there are swamps and inland basins like that of the middle Malagarasi or the scarp-foot swamps of the Mkata or Kilombero. It is mainly where relics of the original peneplain are preserved that the more even topography is more favourable for normal soil conditions suitable for safe agricultural methods. Plateau blocks like the Usambaras or Kasulo, or the mountain masses like the Ulugurus, or the volcanic

slopes of Kilimanjaro, Meru, Tukuyu, or the Porotos, which are favoured by good rainfall, largely on account of their topographical position, are nevertheless, because of their steep slopes, highly susceptible to soil erosion, the ravages of which have already played havoc with portions of these fertile areas. The destruction of forests, especially on watershed slopes, has also already affected the volume and permanence of some important streams. Preservation of remaining forest on the gathering ground of streams, and re-afforestation where devastation has already taken place, are of the utmost importance. The development of new lands demands that these dangers should be avoided.

Some of the inland dischargeless basins in the rain-shadow of high blocks, which intercept the rain from the Indian Ocean, have alkaline or saline soils and arid climates.

It becomes apparent then that the impression which might be gained from an aeroplane of great open spaces inviting development, must be seriously modified when one comes to earth and makes contact with the inexorable facts of the situation. There are vast areas which, for reasons of soil or climate, or both, must be left altogether out of account. There is a great deal of the remainder which is marginal, in one or both of these respects, and will need ameliorative treatment of one kind or another on lines as yet little explored, before it can be profitably occupied. Of normally fertile land much is already occupied by native populations, and some is already overcrowded and deteriorating. There remain, nevertheless, large areas of diversified soil and climate capable of development by methods made possible by adequate finance, but it is clear that a very careful comprehensive economic survey is essential prior to their development. Particular attention should be paid to climate, soil, and water-supply, especially water.

I cannot do better, in conclusion, than quote the words of the late Clement Gillman, recently Water Consultant to the Government of Tanganyika, whose long and devoted experience in the country enabled him to give much sound advice on many aspects of its development. In reviewing the problems of land utilization in Tanganyika Territory he said that his observations have " brought out the outstanding fact that *conservation, direct* or *indirect,* and *increase* of the *country's water resources* form the basis of overcoming most, if not all, of the many obstacles which far from generous climatic conditions and soils raise against the best possible utilization of land that is distinctly the marginal, pioneer-fringe type." I would wish to support also most strongly his persistent plea for a full co-ordination of all scientific data and for a comprehensive economic survey of every major problem prior to embarking on the actual plan of development.

Received November, 1947.

"SHOTS IN THE DARK"
SOME ASPECTS OF FUTURE COTTON PRODUCTION

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An invitation to write an article of this type arouses very different feelings from those which normally attend the preparation of a more technical or scientific paper. The purpose in view is to draw attention to a number of problems which appear to warrant the notice of cotton breeders and technological research workers and, to a lesser extent, those interested in market organization and cotton production policy. Many of the predictions hazarded below will certainly not materialize in the near future, some of them never at all. But such misfires can never be used as evidence against an uninspired prophet because he has the safe defence, "After all, they were only intended as shots in the dark." This article should be regarded in much the same light as casual conversation, in which various topics are touched upon in turn and imagination is allowed to explore unchallenged that fascinating country lying somewhere between the realms of impossibility and practicability.

The position held by cotton in relation to wool, silk and rayon offers a suitable starting-point in a rambling discourse of this nature. The main trends in the production of these four fibres during the past quarter of a century may be roughly summarised as follows: By about 1924 cotton had recovered from the disruptions arising during the 1914-1918 war and world production amounted to about 11·5 million lb., or about 84 per cent. of the total production of cotton, wool, silk and rayon. Wool amounted to 14 per cent. of the total, and rayon, the production of which was rapidly increasing and had already passed that of silk, accounted for about 1 per cent.

In the fifteen years 1924-1939 the world's cotton crop fluctuated according to prevailing economic and agricultural conditions, but showed no tendency to rise or to fall. Wool production increased slightly, silk remained fairly constant during the later part of the period, whereas rayon increased sixteen-fold. Owing to the larger total fibre production at the end of this time, cotton amounted to 72 per cent. of the whole, compared with 14 per cent. for wool, 12 per cent. for rayon and 1 per cent. for silk. During, and following, this last war the production of these major textile fibres decreased because of disturbances to industry, and the need for larger food crops.

Whether the demand for cotton will increase or decrease in the future naturally depends upon many factors. Some of the most important of these may be broadly classified under the three headings:

(i) General world economic conditions.
(ii) Cheapness of supply.
(iii) Development of new, or improvement of present, characteristics.

Cotton in Relation to World Economic Conditions

Rayon has achieved a marked success because (i) it has been applied to many fresh purposes by establishing new consumer demands, and (ii) it has captured some of the markets previously held by cotton (and also other fibres such as wool, silk and flax) on grounds of cheapness or because it more closely satisfies the needs or tastes of the consumer. So far the gross average level of cotton production has not fallen: what has been lost in some fields to rayon and other fibres has been counterbalanced by gains arising from an increase in the general world demand for textiles. As time goes on rayon will continue to expand and capture more of the markets at present served by cotton. Moreover, new synthetic fibres are continually being developed, and these also will acquire some of the markets of cotton if they give a more satisfactory performance for specialized purposes. As economic development of backward areas in the world continues we may anticipate an increasing total demand for textile fibres. Thus, although cotton is faced with a certain and continual loss of markets because of the innovation of new fibres eminently suitable for specific but possibly limited purposes, it does not necessarily follow that the total production of cotton will fall.

This simple picture is complicated, however, by the continual expansion of the world's population resulting in the need for larger food crops. If cotton production markedly declines in the distant future it appears more probable that this will be caused by the need to use the land for raising food for a larger, or a better fed, population rather than by cotton failing to meet competition with other fibres.

Cheapness of Supply

Since 1939 there has been a three- to fourfold increase in the price of raw cotton. The increase in the price of rayon is smaller and staple fibre now sells at a lower price per lb. than cotton, a contrast to pre-war days when cotton was the cheaper fibre. The day has gone when cotton yarns could be sold easily because there were no cheap alternative fibres. Even if cotton is only to maintain many of its present markets the price in relation to rayon must be reduced.

A reduction in the costs of producing cotton may be effected by

three main methods: (i) Increased mechanization in agriculture; (ii) Higher agricultural yields; (iii) Greater economic use of by-products.

As with other crops, the mechanization of cotton production is increasing in many parts of the world. In the U.S.A. and Russia marked advances have been made, but steady development is also taking place in parts of Africa. For example, in the Sudan Gezira mechanical methods are used not only in the annual preparation of subsidiary irrigation channels but also for ground cultivation.

Many further advances must be made in the mechanization of agriculture to effect marked reductions in costs of production and to counter labour shortages. In the U.S.A. great strides have been made not only in ground cultivation but also in the development of operations such as flame-weeding. Mechanical harvesting is continually being improved and the practice is spreading. Satisfactory large-scale applications of mechanical picking no longer seem like unattainable dreams of the future. Experts in the U.S.A. confidently believe that the efficient exploitation of the numerous mechanical methods will lower labour costs and time so appreciably that the price of seed cotton may be reduced to 50 per cent. of that economically required for hand-cultivated and hand-picked cotton.

Because of impending advances elsewhere in the world, the less highly developed areas in Africa cannot afford to permit agriculture to remain static, or only develop slowly. If highly organized countries become able to produce cotton at an appreciably lower price by application of large-scale methods and mechanical aids, then the crop may become uneconomic in more backward areas where it is grown by native cultivators using semi-primitive methods. One way of avoiding this is to effect improvements within the basis of the present framework of native agriculture. In many parts of Africa cotton yields are far below what is possible. These low yields are largely due to inefficient native methods and could be greatly increased (doubled in some cases) if the crops were planted at the most favourable time and received better cultural attention. In the immediate years to come one of the greatest opportunities for increasing production lies in the improvement of native agricultural practices.

It is well recognized that the by-products of cotton should be exploited to the fullest extent. There are areas in the U.S.A., and no doubt elsewhere, where it is not profitable to grow cotton but for the fact that the seed also commands a valuable market. The value of cotton seed per acre may amount to about 25 per cent. of the lint value per acre. In the same way that processors of pork are said to make use of everything about the pig except its squeal, so it is becoming more essential in the full economic use of the cotton crop that there must be more efficient exploitation of linters (from the seed of fuzzy varieties),

of oil which may be extracted for rendering into both edible and non-edible commodities, and of the residual cotton-seed meal for cattle food or fertiliser. In many areas satisfactory development on these lines has taken place, others lag behind full utilization. Who knows, the day may come when one of the major tasks of the plant breeder will be to develop satisfactory cottons having a higher oil content and lower fibrous content without detrimentally affecting yield and lint quality.

As another shot in the dark one is tempted to inquire whether it is not feasible to make greater use of the present bulk crop. In order to encourage the picking and marketing of clean cotton many African authorities offer only a low price for dirty or stained low-grade cotton. The result of this large difference between the prices for clean and dirty or stained cotton is that the native finds it does not pay him to continue picking the later portion of his crop. In Uganda it has been estimated that in some seasons the unpicked portion of the crop may amount to about 10 per cent. of the whole, possibly about 10 million lb. of lint. In other countries also the total of stained poor quality cotton left unpicked reaches high figures. The linters from the American crop is in firm demand as a source of material for rayon and other purposes. The "Scarto" of the Egyptian crop (mainly badly stained lint of very poor quality) adds considerably to the value of the crop. Most forms of cellulose are now in high demand, and are likely to continue so. The day may come when all countries will find it uneconomical to permit a not inconsiderable part of their cotton crop to be left and destroyed in the field, but will seek markets in which it may be profitably disposed.

Development of New, or Improvement of Present, Characteristics

Rayon, and other more recent textile fibres, have established some markets because they are outstandingly suitable for particular purposes. In many cases this is because the producers have deliberately varied the external dimensions and internal structure of synthetic fibres to fulfil special requirements. In the case of cotton, however, there has been virtually no marked advances in developing new types with outstanding characteristics. Most of the cottons grown at the present time could be adequately matched by varieties from crops of the last century, or represent only minor improvements. The V 135 St. Vincent Sea Island provides one exception, being equal in fineness but appreciably longer than the best Sea Island cotton ever grown. Another development of recent times (although the idea was used by the Incas of Peru) is the production of coloured cottons in the U.S.S.R., although these types have yet to prove their commercial importance.

It is interesting to speculate whether, in the future, cotton breeders

will still produce new strains of cotton which, from the technological aspect of ultimate performance, closely resemble those used by our grandfathers or show only slight though nevertheless desirable improvements in fibre character. No matter how marked are the advances on the purely agricultural side of cotton breeding, this work will not enable the uses of cotton to be greatly extended. If cotton is to retain its prominent place then work will need to be directed towards obtaining material of new appeal. One path along which progress may be made is by pushing forward with the development of new chemical finishing treatments for cotton, as for example the modern methods of obtaining crease-resistance. Another line along which advances are being made is the modification of fabric and yarn structure designed to give improved or distinctive service performance. An example of this is the war-time development of close cotton fabrics with increased resistance to air or water penetration.

With the more advanced methods of plant breeding and with the potential new material which may be derived from the uncultivated cottons and from interspecific hybrids, there is a third possible line of advance in the development of entirely new types of cotton. We certainly cannot afford to assume that such projects are impossible until repeated efforts have consistently failed to produce cottons of new appeal and suitable for new uses.

One argument capable of being levelled against any suggested work of this nature is that "cotton spinners are very conservative in their methods and only readily use types of recognized character similar to those found satisfactory in the past." But in this case we regard the argument as inadmissible. We are considering the development of cottons sufficiently distinctive in character to be considered as new types of fibre, for which fresh markets should be sought, rather than cottons which are intended to replace the current types in purposes for which the old ones are eminently suitable. We could not expect an instantaneous welcome for any such unfamiliar arrivals from consumers desiring to extend the scope of their present purchases—the newcomers would have to establish their own markets on the basis of performance in new uses.

We shall indicate a few dark horses which might prove good winners for gamblers desiring to make some developments in the breeding of entirely new types. The list could be easily extended, but our present purpose is solely to draw attention to one aspect of cotton development which appears to have received little attention in the past.

Investigations at the Institute have shown that coarseness of fibre is a major factor in determining the degree to which a cotton will stand up to a harsh abrasive wear after being woven into a fabric. A 100 per cent. increase in the average fibre weight per centimetre

results in about a 40 per cent. increase in the resistance to abrasion. In the present types of cotton an increase in fibre coarseness is generally accompanied by a corresponding marked decrease in staple length, and both factors operate jointly in giving a weak yarn or in the cotton being only suitable for the coarser counts of yarn. There are a few cottons, such as Peruvian Tanguis, Ishan, and some minor growths in the *G. barbadense* group, which tend to be coarser than most other cottons of similar staple length, but they are not very outstanding and their increased length only partly compensates for their coarser fibre.

If an outstanding long, coarse cotton were developed, having a fibre weight per centimetre of, say, a coarse Bengal or native Chinese cotton, and a length appreciably longer than any of the present types, it seems quite possible that it might be suitable for new purposes. This would particularly apply if its intrinsic fibre strength compared more closely with the high values given by long, fine Egyptian or Sea Island material rather than with the low values usually associated with short and coarse cottons. Quite apart from any advantages gained from its increased resistance to abrasion, and hence its suitability for hard and drastic wear, a cotton of this type would probably be suitable for mixing or blending with the longer types of wool, and so extend the markets covered by some of the present cottons. Moreover, there might be other more valuable openings for it in the range of dress and furnishing fabrics. When rayon started its career it was first spun into a fine continuous filament and was regarded as a substitute for natural silk, later finding a field of its own. Subsequently, we had the fine filaments cut into lengths for production of yarns by normal spinning processes—a development which caused rayon to compete with the longer and finer types of cotton. Still later, more distinctive supplies became available: long, coarse fibres for mixing with wool, and also for spinning into yarns for use in cloth having a distinctive canvas and linen-like appearance. The production of an abnormally long and coarse new cotton might also compete with rayon in part of this latter field. The author has seen individual fibres of Sea Island cotton of more than 3½ inches in length on more than one occasion. Fibres of similar length also occur in the tree cotton grown in north Peru. Satisfactory fibre coarseness already exists in a wide range of material. No doubt the plant breeder would have a difficult task to synthesize the two characters together into a stable strain of satisfactory agricultural type, but—nothing venture, nothing have.

The question of a relatively short, fine cotton should not be overlooked. A cotton of this type might find favour with spinners who require extra strength in a silky yarn but whose machines are not wholly suitable for dealing with the normal long staple of the very fine Egyptian types of cotton. For this purpose a suitable cotton

might have a staple length approaching the lowest normally encountered in the Egyptian range, but in fineness approximate to the best qualities. At present the fairly recent introduction of the Egyptian Giza 30 cotton provides the nearest match to this description. Tests at the Institute indicate that Giza 30 has an intrinsic fineness roughly equal to that of the Sakel class of cotton, but in length is intermediate between Giza 7 and the bread and butter Ashmouni-Zagora type. Unfortunately, the intrinsic fibre strength of Giza 30 is little different from that of Ashmouni, and consequently this tends to counterbalance the benefits derived from its fine fibre, with the result that its yarn strength differs little from that of the coarser but slightly longer Giza 7 cotton. As a cautionary note we might add that short, fine cottons would probably prove more suitable for growth in irrigated areas rather than in rain-growing districts. Rain-grown cottons are usually more immature than irrigated cottons, and the increased fineness of fibre would almost certainly accentuate any tendency towards neppiness arising from fibre immaturity.

Another purely speculative idea we are tempted to bring out is whether it would be possible to make use of genetic work on wild cottons to derive a new species of which the lint is of commercially acceptable length, fineness and strength, but which is wholly or nearly free from convolutions. If such a cotton had a high degree of wall thickening it would be expected to give a distinctive handle and a more lustrous appearance to yarn or cloth than arises from the use of the present cultivated types. After all, one of the main purposes of the mercerizing process is to make fibres rounder in section and so give increased lustre. The effect of the absence of convolutions on yarn strength would be of great interest from a fundamental aspect. It is frequently stated that convolutions lead to a marked increase in the grip of fibre on fibre and so materially contribute to the strength of spun yarns. To some extent this is true, but the absolute magnitude of the effect is at present indeterminable. Nevertheless, a cotton free from convolutions would not be expected to give an unduly weak yarn, providing that it had a reasonably high intrinsic fibre strength, and in any case would no doubt be used in fabrics in which appearance, not high strength, was the determining factor. The absence of convolutions might also result in other advantages. Yarns spun from such a cotton would probably be more compact than those spun from the present types, and so might be advantageous for use in some classes of fabrics where close packing is required.

There are many other revolutionary speculations which could be made, ranging from a cotton fibre which did not collapse after boll split into a flattened, twisted ribbon but which substantially retained a large hollow lumen (as in kapok for example), to one having elastic

properties materially different from those of present cottons. Sufficient is given to indicate that unless the apparently impossible is tried many potential new fields of use for cotton must necessarily remain unexplored. The advantages to be gained from one successful innovation may easily outweigh the time and labour expended on a hundred failures. When we come to improving the characteristics of the present types of cotton we are on much safer ground. One almost cast-iron certainty to start with is yarn strength.

High strength is not always essential in a yarn or fabric; good appearance may outweigh other considerations. Nevertheless, high strength is never detrimental in a cotton and may be the deciding factor in choosing one type in preference to another, or in preference to a synthetic fibre. Consequently, there is everything to be said for developing high strength in nearly all classes of cotton, even if only to extend the range of purposes for which a given variety is suitable.

Long, fine cottons are usually cottons of high intrinsic fibre strength; the reverse generally holds for short, coarse cottons. Consequently, from the length and fineness of a cotton we normally obtain a reasonable index of yarn strength because these characters largely determine the yarn strength and moreover they usually indirectly take into consideration the contribution arising from the fibre strength, because of the general linkage between the three characters. Nevertheless, apparent anomalies arise from time to time. Different samples of the same cotton may give yarns consistently strong, or weak, compared with others from cottons of similar length and fineness, because of their unusually high, or low, fibre strength.

Among the cultivated types of cotton there is a considerable range of variation in intrinsic fibre strength. This suggests that there is scope to effect improvement among the weaker types by crossing them with the stronger cottons. There is, however, another and far more valuable source of high fibre strength. It has been found that at least some of the American diploid cottons, although virtually hairless, carry a potentiality for high fibre strength which can be introduced into cultivated types. Work is in progress to transfer increased fibre strength isolated from *G. thurberi* into other commercially valuable cottons. Results to date suggest that in this way it is theoretically possible to increase the strength of the strongest present-day cottons by as much as 20 to 25 per cent., and of the weaker ones by much more.

Another line along which progress may be made lies in overcoming the difficulty of neppiness. It is well known that one common complaint of spinners about the American types of cotton grown in Africa is that their use leads to neppy yarns. American cotton from the U.S.A., on the other hand, is also sometimes neppy, but it is certainly true that as a whole the U.S. crop is less neppy than African cotton.

Not infrequently, African cottons have less well-developed walls—that is, they have a low fibre maturity. This low degree of secondary thickening is one of the major causes of their general neppiness. Consequently, one promising way of reducing neppiness is to develop strains having a greater degree of secondary thickening than the present types. The mode of deposition of secondary cellulose affords a very fertile field of study to physiologists; in the past the physiology of lint and seed development has been largely neglected in favour of studies of plant mechanism. The causes of low secondary thickening are, however, by no means wholly physiological. To some extent fibre maturity is a genetic factor, and there is now sufficient evidence to show that many of the present stocks contain enough genetic variation for better maturing types to be evolved from them.

Neppiness appears to be aggravated by undue length and fineness of the fibre. Generally an immature sample of a medium staple coarse cotton will not give a yarn as neppy as an equally immature but appreciably longer and finer cotton. Therein lies the source of many complaints against neppiness of African cottons. Nearly all of the American types of cotton grown in Africa are appreciably finer than typical cotton from the U.S.A. of similar staple length. A degree of immaturity which can be tolerated in cotton from the U.S.A. would very frequently give rise to neppiness in the finer African cottons. The Triumph type of cotton grown in the Belgian Congo is one example of an African cotton which is not fine. Although this cotton is usually no more mature than crops grown elsewhere in Africa, its coarse fibre rarely gives rise to complaints on grounds of undue neppiness. Hence it would seem that if Africa grew coarser types of cotton, more similar in character to those forming the U.S.A. crop, there would be reduced neppiness trouble. The solution is not quite so simple as this, and would be feasible only if a lower yarn strength (resulting from the coarser fibre) were acceptable. Consequently, until it is found possible to tap the source of genetic variance and breed a more mature type of material, or until increased fibre strength is added to the coarser types of cotton, the choice before many of the Empire countries in Africa is to grow a fine but immature cotton giving yarns prone to neppiness, or a coarser type of cotton which, although no more mature, gives yarns of satisfactory appearance but of appreciably lower strength. In other words, unlike the U.S.A., most African countries cannot have their bread buttered on both sides.

Received November, 1947.

COTTON GROWING IN GREECE

BY

TREVOR TROUGHT, M.A.

THE author recently spent a few weeks in Greece as temporary Agricultural Adviser to the British Economic Mission there, with instructions to examine the cotton-growing industry and report thereon. He had every facility granted him to make his enquiries, and the following notes and impressions may be of interest to readers of the EMPIRE COTTON GROWING REVIEW.

The history of cotton growing in Greece starts with the writings of Pausanias in A.D. 180, but for the purposes of this note 1931 saw the real beginning of serious cotton growing. For fifteen or twenty years before that date the importance of the Greek *spinning* industry had been gradually increasing and the desire to use locally grown cotton instead of imported cotton naturally directed attention to the possibilities of increasing the home crop.

The climate of Greece had been proved suitable for the crop for nearly two thousand years; the problem now was to find out how and where it could be grown at a profit, and the best varieties to grow for the benefit of the spinning industry. It was the spinners who had the first consideration. In Greece, where the spinners and growers are in the same country, closer co-operation might have been expected, but it is only recently that the question of growers' costs has been seriously investigated. Much more still must be done before it can be certain that the grower does not produce his crop at a loss. The argument that was used at one time to justify the growing of cotton on land which would only produce half a crop was that " the farmer had to have something to do in the summer; if he didn't grow cotton he wouldn't have any work to do, and even if he did only get half a crop he would get some cash for it !" A specious argument! But it should not be beyond the wit of man to find a crop which will show a profit when the farmer's own labour and that of his family is properly taken into account in the costing.

In 1931 the Administration founded an organization called the " Cotton Institute," which was autonomous and financed by a tax on imported cotton. The object of this Institute was to extend the cotton-growing area and undertake scientific work on the selection and propagation of varieties, increasing yield and G.O.T., to study the

control of cotton pests and diseases, and also to study the organization and improvement of the local textile trade.

Seed was imported from the United States—the variety Acala was the most favoured—seed production areas and one-variety communities were set up, and intensive propaganda undertaken in areas where cotton growing was capable of being either established or increased. Research Laboratories and a Research Farm at Sindos, near Salonika, were established.

The results were quickly seen, between 1932 and 1937, in a steady increase in the area under cotton. In 1937 political difficulties occurred, and the Sindos Research Station was withdrawn from the Cotton Institute and put under the Ministry of Agriculture. The " Institute " was renamed the " Cotton Organization " and the Sindos centre the " Cotton Research Institute." Lack of co-ordination and the outbreak of war have resulted in the complete breakdown of this very promising effort to place the cotton-growing industry on a sound scientific foundation. Since the war the Cotton Research Institute has begun to revive, though the replacement of destroyed equipment and an adequate staff are still required. The Cotton Organization suffers from a lack of technical direction, although it has a fairly adequate modern technological equipment.

The climate of Greece is damp and cool in the winter, October to March, but quite warm enough in the summer months to grow cotton. There is little rain in the summer, which, however, is not so warm as in Egypt. The temperatures and humidities fall within the limits set by C. B. Williams* for successful cotton cultivation. The average rainfall is about 16 in., of which 12 in. fall in the winter.

Soils are very variable in their origin and type, but in general it can be said that cotton is grown on the alluvial soils of the valleys. They are considered to be poor, but this may be due more to a failure to keep them in good heart than to their intrinsic lack of soil nutrients. Where irrigation is available and some form of rotation is employed (as, for example, at the Experimental Farm at Sindos) very good yields of cotton, comparable with yields in other countries, can be obtained. In " dry " areas the yields are, however, poor, as would be expected. No crop can grow without water.

The cotton-growing areas are scattered throughout the country; Macedonia and the eastern half of what is known as " Continental Greece " are the two most important areas. Yet, in spite of the differing conditions of soil and climate, the actual cultivations of the crop do not vary much.

A ploughing is done in the autumn—generally in October—when a suitable rain occurs. The land is then left to absorb the winter rainfall

* *Technical Bulletin, No. 32*, 1923, Ministry of Agriculture, Cairo.

until a favourable day in February or early March, when a second ploughing is given. A third ploughing is done later in March or in April, before sowing starts in May.

The ploughing is followed by a harrowing. This is really a clod-crushing, as the implement used is a plain wooden frame dragged by a pair of horses across the field when the ploughing is finished, the driver standing on the frame to add a little weight. In Egypt or the Sudan this would be called "zahaffing." In the Argos district a small elaboration of the implement was seen, the frame being interwoven with pliant withies. If the soil is caught at the right moment quite a good tilth can be obtained.

Where continuous cotton is grown, the first ploughing is left till spring. In the Levadhia district this continuous cotton-growing practice is common and the first ploughing out of the cotton stalks was just being done in April. It was stoutly maintained by the local cultivators and the local agronomist that this normally reprehensible practice was quite safe for that particular district. This in spite of the fact that a live pink boll worm was actually found by the agronomist while the discussion was in progress. It was said that there were very few pests and diseases, the winter was sufficiently severe to destroy most, and thus keep any which did exist in control, and—the final argument—as the fields were flooded during most of the winter, there was no other crop which could be sown. This flooding leaves silt on the fields and is equal to "warping" in restoring their fertility. The estimated yields for the district were certainly good, but the growth of the plant, judged on the old sticks, could be much better. This habit of continuous cotton growing ought to be re-examined critically and experimentally, to ensure that there is, in fact, no danger from pests, and to test whether better yields and growth could be obtained by the introduction of other crops in rotation.

The most usual sowing date is from the end of April till the middle of May, though experimental work at Sindos seems to show that the earlier the sowing in April, the better the yield in the western Macedonian area. There is a risk, however, in this early sowing of a complete failure and a full resowing having to be done. By May the soil should have warmed up enough for rapid germination. Sowing is generally done by hand. Many farmers would like to use a small single-row cotton drill, but there are not enough of these to go round. The Co-operative Societies possess a few which are loaned to members, but many more are required. In the Argos district dibbling is the usual method, but this is slow, laborious and costly. A small mattock-like hoe is used for making the holes into which the seed is dropped and then covered. Broadcasting is the more general method in Levadhia and Salonika districts. A harrowing to cover the seed is given. Some-

times the seed is sown in the furrow of the last ploughing. Resowing is not a general practice.

The seed takes seven to ten days to germinate, and when it is through the ground a number of hand hoeings are done to destroy weeds. This is carried out with care and thoroughness. The importance of clean crops is well understood. As it is all done by hand it is an expensive operation, though the farmer's family (the women in particular) do most of it, and there is not that disbursement of cash which would bring home its heavy cost if the labour were priced at its market value.

The extended use of a seed drill which would allow the use of a small horse hoe would help to reduce these costs. There are possibilities that the small type of motor hand hoe and "Trusty Tractor" plough, as used by market gardeners in England, will be found to have considerable value in Greek agriculture in the future. The holdings are small and cannot be expected to bear the costs of full-size tractor-drawn implements. The co-operative movement has here a possibility of being of much more use than it is at present. The well-organized societies are doing good work now, but the standard of the societies is uneven and a lot still can be done.

Any thinning out of the cotton is done at the first hoeing, but on the whole little importance is attached to spacing at present. This is one of the items which is under experimental investigation, but till cotton is sown in lines the results cannot be of practical application.

Picking begins in September, and may go on till December. As a rule four pickings are taken, but occasionally the first picking is delayed so that more bolls may open and ease the work of the pickers. All picking, of course, is done by hand and is expensive. Again, much is done by the farmer's family, but the shortage of agricultural labour may be acute at this time, with a consequent increase in the labourer's wage—in fact, the labourer may demand almost any price he likes and the farmer has to pay it. This shortage of labour can be attributed partly to the German occupation, as many workers were attracted to the towns at the time when relief food supplies were being distributed and have remained there, taking up urban employment.

On irrigated land (about 30 per cent. of the cotton area was reputed to be irrigated) yield estimates of the farmers themselves were in the neighbourhood of 1,100 lbs. of seed cotton per acre. The "dry" land was expected to give about 400-450 lbs. per acre. These estimates are probably a little optimistic, though at Sindos higher yields have been obtained on small plots and show that there is still scope for improving the average yield per acre for the country. Over the last twenty-five years this has worked out at not more than 200-250 lbs. of lint per acre.

The collection of the seed cotton from the farmer is one of the weakest

points in the industry. The simplest and best method from the farmer's point of view is that followed in those more rare cases where the farmer hands over the seed cotton to his Co-operative Society, which gins it and markets the lint. The farmer gets his money at once, and any profit made in further transactions comes back to him later. But this arrangement is not always possible, as not all the societies by any means have their own gins, though there is a movement afoot for the societies to buy their own ginneries. Many gins are privately owned, and consist of one or two gins only, often run by water power. The farmer can thus bring in his seed cotton to the local town and have it ginned for his own account. The cost is more or less standardized at 4 per cent. of the value, either in cash or kind. He then takes lint and seed back to his village and later brings the lint back to a collecting centre for collection by the Government agency. As he also may have to wait a number of days before his ginning can be done, there is room for much delay and wasted time. Again, the merchant may send agents to the village to buy direct from the farmer. As the farmer is generally hard up for ready cash, there is here an all-too-easy chance for exploitation. In any case, there is no inducement for the farmer to pick cleanly and try to improve his grade, as he himself reaps no benefit from such improvement.

The Government agency for the collection of the cotton is an organization known universally as K.Y.D.E.P. This is a "Co-operative of Co-operative Unions." All the Co-operative Unions are represented and contribute. In many cases the K.Y.D.E.P. works through the Union of a district. This is the regional organization for the local Village Co-operative Societies. The co-operative organization is very good—better than in many other countries—but when it comes to the actual working together for mutual benefit, the Greek is essentially an individualist, with the result that the collection is not done as rapidly and efficiently as might be (there is, perhaps, too much argument about it), and the spinner does not get his supplies when and where he wants them. The spinner nevertheless is tied to K.Y.D.E.P. for his supplies, and is compelled by law to use a certain quota of home-grown cotton in his mill. Financial reasons (such as scarcity of foreign exchange, for example) may make these restrictions necessary for the time being, but the hope of improving the quality of the yarn produced meanwhile is thereby lessened.

To sum up briefly, the Greek cotton-growing industry is considered to be an important one in the economic life of the country. Cotton can be grown easily and well. But owing to the war, what was a promising industry, developing on modern well-tried lines, has become confused and disorganized. It is very difficult indeed to suggest any simple solution to the problem of putting the industry on its feet again. It is

a problem of a primitive agriculture burdened with civilized labour costs. There must be a revival and intensification of research in all aspects of cotton growing. Practically every side of the work—plant breeding, plant physiology, plant protection, sowing dates, manurial requirements, cultivations (particularly mechanical cultivations and their effect on the soil structure)—requires to be enlarged. At the same time a propaganda service to the farmers and improved rural education must go hand in hand with research, so that the results of research "get across."

But, without being pessimistic, it must not be forgotten that while this building up is going on, the well-established cotton areas are also improving their yields and quality by similar means, and in the end Greece may still be unable to compete in the open market with these other growths. A question, therefore, which would seem to require the most careful consideration by the proper authority, is whether it would not be a more paying policy in the long run to devote time and research to the development of a crop which Greece can export, rather than reduce imports by growing its own cotton.

Received September, 1947.

EGYPTIAN COTTON-BREEDING TECHNIQUE

BY

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It is generally recognized now that scientific agricultural and selection methods must be adapted to the special conditions of the crop and country being dealt with. The extent to which the experience of one country is valid for that of another is therefore not perhaps so great as has at one time been believed.

Egyptian experiences may thus not be of direct value to cotton workers in Empire countries, but the Egyptian crop is of sufficient importance in the world range of cottons to have general interest for cotton workers everywhere. The recommencement of regular issues of the Empire Cotton Growing Review gives me an opportunity to put on record recent changes in the Egyptian crops and techniques of work, with an attempt to indicate those points likely to be of general interest to cotton workers elsewhere.

The majority of work done has been the attempt to make the most profitable exploitation of that degree of variability and " selectionability " which still appears to exist in considerable degree in the Egyptian crop. The main types of commercial importance so far launched on the market from this work are Karnak (Giza 29), Menufi (Giza 36), Amon (Giza 39) and Giza 30. It will be recollected that at the time of the substitution of Giza 7 for Sakel, the former was claimed to have a 40 per cent. yield advantage, though with a somewhat lower quality. Karnak has shown itself able to maintain this 40 per cent. yield advantage, with a quality right back to the standard of the original Sakel. Menufi has a quality between Giza 7 and Karnak, with a still higher yield, approximately equal to that of the high-yielding short staple Zagora type (Ashmuni seed grown in the Delta).

Giza 30 is the first of a new series of introductions of medium staple varieties even higher than Zagora in yield, and therefore higher, as far as is known, in intrinsic yielding ability than any Delta types previously grown. The existing world shortage of good quality medium staple types is likely to lead to a rapid expansion of this desirable type, which has a staple somewhat better and lighter coloured than Ashmuni.

Giza 30 is a good example of the selection of a type showing a desirable

genetic combination, irrespective of what would have been expected from its actual parentage, and, it must be admitted, with little or no actual understanding of how this particular genetic combination was achieved. Giza 30 is actually a cross between Giza 7, a good-medium staple, with Sakha 11, a high quality off-type Sea Island, and its low-medium quality is below that of the lower quality parent, while its yield is appreciably higher than either parent.

The same unpredictable result gave us Amon (Giza 39), which, while a cross of two high quality varieties, Malaki and Sakha 4, is actually finer than either parent, and derives its superior yarn strength mainly from this fineness.

The present technique employed in this crossing work at Giza is to build up a stock of parents with extreme qualities in any direction, however and wherever obtained, and regardless of whether this extreme character is or is not combined with others to make a desirable commercial variety. By recrossing these extremes in different combinations it is hoped to extend still further the extreme ranges, and retain or even increase the present range of desirable selection material. For any country's crop, as a whole, it cannot be too strongly emphasized that preservation of a wide range of variability is as important in the long run as preservation of the purity of any individual variety of that crop is in the short run. Examples of extreme parents at present available at Giza are:

Maximum length: Giza 49, from the cross Giza 26 (Malaki) × Giza 29 (Karnak).

Maximum boll size: Giza 48, from the cross Giza 12 (Wafeer) × Giza 29.

Maximum G.O.T.: Giza 35, from the cross Giza 7 × Giza 17.

Maximum whiteness: Giza 40, from the cross Giza 25 × Sakha 4.

Even more interesting from a quality point of view are two new types, Giza 44 and Giza 45. The former, from the cross Giza 30 × Sakha 8, has given us maximum strength anomaly, a term at present used at Giza to denote yarn strength higher than would be expected from the measured length and fineness. Giza 44 is of the same hair weight as Karnak, but, though shorter than Karnak, gives a stronger yarn. It would, of course, have been an extremely interesting potential commercial type if its yield had been equal to Karnak. Tests, however, have shown that it is not, and the cotton is now included in the range of parents referred to above.

Giza 45 is from the cross Giza 7 × Giza 28, the second of these being a high quality type of origin Sakha 3 × Sakha 4. But with Giza 7 as the other parent it is most surprising to find this cross giving, as it has, lint finer than that of Giza 39 and the highest yarn strength

so far available from Egyptian cotton, again apparently mainly due to this fineness. Since Giza 45 has also excellent agricultural merits, its substitution for Giza 39 under the same commercial name of Amon is at present under consideration. Luckily there is a close similarity in the general lint characteristics of the two strains.

It might be thought that the obvious line for improvement in Egyptian quality would be in crossing with Sea Island types, themselves believed to be one of the original components of the Egyptian make-up. Several such types were introduced in the early 1920's, but nothing of these survived test except the Sakha 10 and Sakha 11 selections, which were off-types found in an introduced St. Kitts stock. Sakha 10 is a parent of Giza 26, and thus has a part in the parentage of Giza 39, but Sakha 11 only survives in the blood of Giza 30.

Recently fresh Montserrat and St. Vincent introductions were made and crossed with several Egyptian types, but these Sea Islands are, under Egyptian conditions, distinctly later maturing than Egyptian varieties. This lateness was also carried over into most of the hybrid progeny. Of the various crosses made, only St. Vincent × Giza 36 still survives, and this shows little commercial promise. In general the Sea Island crosses give weaker yarn than all Egyptian types of corresponding length and fineness; in our terms, have lower strength anomaly.

A new technique for the maintenance of nucleus stocks of established varieties is now in operation at Giza. This consists essentially in the comparison, with the existing bulk stock as a control, of any ten plant progenies showing apparently typical characters in the single plant stage. The actual selection of the ten is made on yield, not because it is believed there is any reliability in yield selection made at this stage, but entirely to get the maximum quantity of seed for the subsequent bulking and testing. This testing is done for two years in miniature chequers with two controls of the bulk, followed by one year's test in a yield chequer of the best five with one control. Final selection of the best family as a new nucleus is followed by a recommencement of single plant selection from selfed seed, the whole process giving us a new nucleus of single plant origin every four to five years (the cycle is lengthened a little if indecisive results indicate the necessity for repeat tests before a final choice can be made).

The interesting point of this technique is that, giving, as it does, more extensive chequer tests than those previously made of related sister families of the same variety origin, no variety has yet been found showing no genetic differences.

Received May, 1947.

PROSPECTS FOR WORLD RAW COTTON PRODUCTION AND CONSUMPTION IN 1947-48 —A PRELIMINARY SURVEY

BY

DUDLEY WINDEL

OVER the nine seasons ending with the 1944-45 season world stocks of raw cotton expanded from 13,695,000 bales to 26,487,000 bales, the increase comprising 5,915,000 bales of American cotton and 6,877,000 bales of other growths.

SUPPLY AND DISTRIBUTION OF ALL COMMERCIAL COTTON IN THE WORLD*

AMERICAN IN RUNNING BALES; OTHER COTTONS IN EQUIVALENT 478 LB. NET BALES (000'S OMITTED)

Season	*Carryover August 1*	*Production.*	*Total Supply.*	*Consumption.*	*Destroyed.*	*Carryover July 31.*
1936-37 ..	13,649	30,729	44,378	30,638	45	13,695
1937-38 ..	13,695	36,745	50,440	27,573	165	22,702
1938-39 ..	22,702	27,509	50,211	28,507	66	21,638
1939-40 ..	21,638	27,326	48,964	28,496	206	20,262
1940-41 ..	20,262	28,720	48,982	26,595	220	22,167
1941-42 ..	22,167	25,616	47,783	25,033	165	22,585
1942-43 ..	22,585	25,582	48,167	24,293	304	23,570
1943-44 ..	23,570	24,521	48,091	22,566	121	25,404
1944-45 ..	25,404	23,391	48,795	22,150	158	26,487
1945-46 ..	26,487	20,552	47,039	23,541	150	23,348
1946-47 ..	23,348	20,438	43,786	25,780	150	17,856
1947-48 ..	17,856	24,340	42,196	25,960	170	16,066

* Source: New York Cotton Exchange to 1945-46. Writer's estimates 1946-47 and 1947-48.

The big increase in world stocks in 1937-38 was due almost entirely to the bumper American crop in that season of 18,267,000 bales. It will be noticed that during the war years (1939-45) there was no important variation in the total world supply, both production and consumption contracting in about the same proportions. The reduction in the former was due largely to reduced acreages in Egypt, India, China and Africa, which were necessitated by increasing scarcities of foodstuffs and war dislocations. The reduction in the latter resulted mainly from the cutting off of mills in Continental Europe, Japan and China from their normal sources of raw cotton supplies, and the enforced concentration of the British cotton industry. The decline

in the world figure would have been much more severe but for a marked expansion in textile production by the U.S.A., Indian and South American mills during this period.

Since the termination of the war in 1944-45, world raw cotton production has decreased further. This is due principally to reduced acreages in the United States, India and China, and to very poor yields in Brazil and Argentina in the past two seasons as a result of unfavourable growing conditions. On the other hand, world consumption in 1945-46 and 1946-47 showed a progressive upward trend as Continental, Japanese and Chinese mills resumed active operations.

WORLD CARRYOVER AND PRODUCTION OF COMMERCIAL COTTON IN THE WORLD*

AMERICAN IN RUNNING BALES; OTHER GROWTHS IN EQUIVALENT 478 LB. NET BALES (000'S OMITTED)

World Stocks, July 31, 1947.	
U.S.A.	2,520
Canada	140
Mexico	200
Other N. America	10
Brazil	2,200
Argentina	350
Peru	186
Other S. America	70
U.K.	1,950
France	600
Italy	700
Russia	1,000
Germany	150
Holland	120
Belgium	300
Switzerland	100
Sweden	90
Spain	80
Czechoslovakia	80
Yugoslavia	40
Poland	60
Other Continent	40
India	3,600
China	450
Other Asia	200
Egypt	1,350
Belgian Congo	100
Other Africa	400
Japan	200
Australia, etc.	70
Afloat	500
	17,856

World Production, 1947-48	
U.S.A.	11,200
Mexico	460
Other N. America	30
Brazil	1,400
Argentina	400
Peru	320
Other S. America	100
Continental Europe	130
Russia	2,950
Turkey	250
Persia	80
India	3,400
China	1,000
Burma	25
Other Asia	250
Egypt	1,400
Belgian Congo	190
Uganda	180
Tanganyika	35
Nigeria	30
French Africa	120
Portuguese Africa	140
Sudan	220
Other Africa	25
Australia	5
	24,340

* Tentative estimates.

THE 1947-48 SUPPLY PROSPECT

Estimates of world production and consumption for the current season must necessarily be highly tentative at this early stage, as the Northern Hemisphere crops are not fully harvested and the Southern Hemisphere crops have only recently been planted. On the basis of available data, however, the broad world supply outlook appears as shown in the foregoing table.

An analysis of the 1947 world stock figures indicates that the active export movement of the past two years has not only reduced the very large reserves accumulated in producing countries during the war period to near normal proportions, but has also enabled most consuming countries to rebuild their depleted stocks. For this reason, it would seem unlikely that world exports from producing countries this season will exceed 7,000,000 bales, as against 9,466,000 bales actually exported last season.

WORLD PRODUCTION IN 1947-48

Planted cotton acreages this season appear to have moderately increased in the U.S.A., Egypt, Russia, China and Argentina, but to be little changed elsewhere except in Brazil, where the area is reported to be reduced by about 20 per cent. Prospects for the harvests in the various producing countries are tentatively summarized below:

NORTH AMERICA

United States.—Acreage planted to cotton this year was 21,389,000 acres, as against 18,316,000 acres in the previous season. Growing conditions have been more favourable and the prospective average yield per acre is consequently moderately higher. The indicated production is 11,221,000 bales, compared with a final 1946-47 out-turn of 8,517,000 bales. The crop is unusually high in grade owing to the predominance of hot dry weather.

Mexico.—Acreage planted this year was 15 to 20 per cent. higher than in 1946. The average yield per acre, however, did not come up to expectations, and the estimated harvest of 460,000 bales (478 lb. nett.) shows little change on the 1946-47 figure.

SOUTH AMERICA

Brazil.—Owing to very disappointing cotton yields over the past two seasons, growers in South Brazil have turned over more land to food crops this year and the planted acreage is estimated at 15 to 20 per cent. smaller than in 1946. Autumn weather was favourable and the crop made a promising start. Consequently, despite the re-

duced acreage, a harvest at least as large as last year's very poor out-turn can reasonably be expected. Acreages sown to cotton in the Northern States have remained fairly constant in recent seasons and the current crop is expected to reach the normal figure of about 450,000 bales (478 lb. net).

Peru.—The 1946-47 growing season was very unfavourable and the crop was well below the average in both quantity and quality. The acreage planted this autumn is not believed to be much changed from that of recent seasons, and given generally favourable weather a yield of rather more than 300,000 bales (478 lb. net) should be attained.

Argentina.—Crops in the 1945-46 and 1946-47 seasons were partial failures owing to adverse climatic conditions and heavy insect damage. Acreage planted this year is believed to be 10 to 15 per cent. larger than last year, but the harvest prospect is very uncertain as the country is plagued by a serious infestation of locusts.

Africa

Egypt.—Acreage planted in the spring of 1947 at 1,254,154 feddans was slightly larger than the 1,212,701 feddans planted a year ago. The growing season has been favourable except in parts of the Delta, and a harvest moderately larger than the 1,252,000 bales (equivalent 478 lb. net) gathered last season is generally anticipated. In accordance with a Government decree the area sown to Karnak and other long staples in Lower Egypt was drastically reduced in favour of short-stapled Zagora.

Sudan.—Acreage under cotton this season is believed to be little changed from the 1946-47 area, and a normal yield of around 220,000 bales (478 lb. net) is anticipated.

British East Africa.—Acreage planted to cotton in Uganda this autumn is about 10 per cent. less than last season, and a harvest somewhat smaller than the 1946-47 out-turn of 183,000 bales (478 lb. net) appears in prospect. This season's Tanganyika crop at 35,000 bales (478 lb. net) was approximately the same as the yield for the previous season.

Belgian Congo.—Acreages planted and production have been more or less uniform for several seasons, and the 1947-48 crop is expected to reach the normal figure of around 190,000 bales (478 lb. net).

French Equatorial Africa.—Production of raw cotton has shown a steady upward trend over the past decade under French Government encouragement. The 1947-48 crop is estimated at around 120,000 bales (478 lb. net).

Portuguese Africa.—The 1947-48 harvests in Angola and Mozambique are expected to be fully equal to the average of previous seasons, and a total yield of around 140,000 bales (478 lb. net) is unofficially predicted.

British West Africa.—Scarcity of foodstuffs has prevented any

important increase in the Nigerian cotton area. Yields from the 1947-48 harvest are estimated at close to the normal figure of 35,000 to 40,000 bales (478 lb. net).

Europe

Continent.—Aggregate cotton production in Greece, Bulgaria, Roumania, Italy, Yugoslavia and Spain, which declined sharply during the war years, has now been restored almost to the pre-war normal. The 1947-48 total out-turn is estimated at 130,000 bales (478 lb. net).

Asia

Russia.—No official statistics of cotton production in the U.S.S.R. are published. According to data received from unofficial sources, the total Russian harvest fell during the war years from the pre-war average of 3,500,000 bales (478 lb. net) to below 2,000,000 bales. Since then, however, production appears to have made a good recovery and the 1947-48 crop is reported to be near to 3,000,000 bales.

India.—The cotton acreage in recent seasons has been restricted to around 14,800,000 acres by Indian Government regulations because of an acute scarcity of foodstuffs. Prospects for the 1947-48 harvest are very uncertain on account of the communal upheaval in Sind and the Punjab which followed the constitutional division of the country. Better yields than last season are anticipated in most of the cotton-growing areas within the Dominion of India, but in the Dominion of Pakistan it is feared that between a quarter and a half of the Punjab crop will be lost as a result of the migration of populations. Taking all factors into consideration, it would seem reasonable to expect a total 1947-48 yield of between 3,300,000 and 3,600,000 bales (478 lb. net).

China.—Cotton growing in China declined severely during the world-war period. A much larger area, however, was planted in 1947 and the current crop is unofficially estimated at around 2,200,000 bales (478 lb. net). There is, nevertheless, considerable doubt as to the amount of cotton that will be available for commercial use on account of the chaotic conditions prevailing in the cotton-growing areas. The civil war between the Central Government and the Communists has severely disorganized transport, and the mills in Shanghai and elsewhere will be fortunate if they can obtain delivery of as much as 1,000,000 bales.

WORLD CONSUMPTION OF RAW COTTON

To make a reliable forecast of world consumption during the 1947-48 season is extremely difficult in face of the unstable political and economic

conditions currently prevailing. Broad indications, however, point to the following very tentative estimates for the various principal consuming countries:

AMERICAN IN RUNNING BALES; OTHER GROWTHS IN EQUIVALENT 478 LB. NET BALES (000'S OMITTED)

U.S.A.	9,250
Canada	370
U.K.	1,850
France	950
Germany	250
Italy	600
Belgium	400
Czechoslovakia	250
Holland	230
Poland	350
Spain	250
Switzerland	100
Portugal	160
Sweden	120
Other Continent	240
Russia	2,400
China	1,600
India	3,300
Japan	750
Other Asia	400
Brazil	1,000
Argentina	380
Peru	60
Other countries	700
Total	25,960

World consumption in 1946-47 is estimated at 25,780,000 bales, so that the prospective consumption in 1947-48 is only slightly larger. The U.S.A. mills are expected to use about 800,000 bales less than last season, but this reduction will probably be more than offset by increases in the United Kingdom, Russia, most European Continental countries and India.

CONCLUSIONS

The tentative estimates of world raw cotton production and consumption previously given suggest that the 1947-48 world crop will fall short of world consumption by 1,790,000 bales and that the world carry-over on July 31, 1948, will be reduced to around 16,000,000 bales. Over the past three seasons, world reserves have fallen by nearly 10,500,000 bales and it is clearly evident that, unless this trend is soon reversed by a further expansion in world production, a tight supply position cannot be far ahead. The prospective deficiency in production could, of course, be corrected by a contraction in the rate of world consumption. Such a development, however, is difficult to envisage,

as, before the war, world consumption averaged about 29,000,000 bales annually, and the population requiring textiles in all the five Continents has increased appreciably since then. The great mass of mankind on this planet is today only half clothed. The potential demand for cotton goods of all kinds is enormous. The productivity of the soil and the efficiency of industry in most parts of the world could be raised several-fold by the application of modern scientific techniques. All that fundamentally stands in the way of a much higher level of material prosperity for everyone is the lack of any real spirit of international understanding and goodwill.

Received November, 1947.

REVIEWS

Les Lotissements Agricoles du Nord-Sankuru. By A. Brixhe. (Centre d'Etude des Problèmes Sociaux Indigènes, Elizabethville, Congo Belge.) This pamphlet is a reprint of an article in the review *Lovania* by M. A. Brixhe, Agricultural Adviser of the Compagnie Cotonnière Congolaise. The author describes the measures taken for the permanent agricultural resettlement of certain village populations whose locations, owing to soil deterioration, had become inadequate to supply their needs. Increasing population and extension of export crops are giving rise to similar situations as we know, in many parts of the African continent, and in some areas of the British Colonies their urgency is currently recognized. The author disclaims any idea that the particular method adopted in these experiments can be universally applied; conditions vary much too widely for that to be possible, but his examples, besides being interesting in their local application, bring in some general principles which are highly relevant to the discussions taking place, in this Review as elsewhere, on native production. Beyond the basic requirement of stabilizing native occupation of land, and preventing progressive deterioration, there is the further need of social and agricultural organization of a character which will permit, without undue pressure, of that direction and control failing which, it is safe to say, little progress can be made towards the realization of the optimistic projects, now so widely entertained, of calling in the continent of Africa to restore the failing resources of Europe.

The district concerned is in the Province of Lusambo, source of the rivers of the Central Congo, where immense savannahs come up abruptly against the high walls of the equatorial forest. The nature of the soil—the vital factor—is far removed from the popular idea of a tropical soil. Alike on the savannahs and under the forest cover it is sandy, poor in colloids, and resting on a subsoil little different in structure. It is highly pervious, so that even under heavy rains erosion is negligible. The humus-bearing layer is very shallow, its upper surface composed of a mat of rootlets, the decomposition of which is a necessary preliminary to the establishment of such crops as groundnuts and cotton. From such a soil exposure to a tropical sun—with the reactions, chemical and biological, activated by high temperatures—and severe leaching under heavy rainfall rapidly remove fertility. The only possible agriculture for annual crops must have a short rotation and a cultural system which, as far as possible, gives continuous cover. The unguided native cultivator observes no such limitations. His only alternative the heavy labour of making a new clearing in the forest, he clings undernourished to his impoverished plot until its dwindling returns will no longer keep him alive. Dispersal and more unregulated drafts on the forest capital ensue.

The attempt to establish a permanent system in these unfavourable circumstances must have required a high degree of courage and determination. The means to carry out the work involved were supplied by the two cotton companies established in the region. The

objectives decided upon for the new settlements, were the choice of the best available forest site, the definite location of cultivation, the imposition of a precise rotation, and the observance of a sufficient regenerative fallow. The plan itself is bold and simple. A block of forest of the required size, determined by the number of prospective occupiers, is selected by exploration, taking into account the general lie of the land and the nature of the forest cover. A base line is fixed, and sufficient parallel traces run out at right angles to confirm the choice, after which traces are cut every 300 metres each way to complete the survey. The planting system is based on a four-year rotation, in accord with local food requirements: (1) rice interplanted with cassava, (2) rice, (3) cassava, (4) cotton, followed by groundnuts or millet, and in the fifth year, cassava planted to initiate a bush fallow. Plots corresponding to the number of adult able-bodied males concerned are measured along the base line so as to give an initial area to each of 40 ares (about 1 acre) to be felled, burned, and used for the first year's planting; cultivation advances by a like area each year, reaching its maximum when 2 hectares have been cleared. The period of regeneration is fixed at 15 years, so that in 20 years the process begins to repeat. The ground occupied per cultivator is thus 8 hectares in theory; 9 are allotted in practice to provide a margin. At intervals between the allotments reserves are left which serve to cover marked inequalities of terrain where these exist, to provide alternative plots when required, and to accommodate newcomers. It will be noted that the system has considerable elasticity: the period of regeneration is adjustable according to local conditions, the number of plots is adjusted to the number of families, and groupings can be arranged to correspond with tribal, clan, or family divisions. Elements of the community with no responsible able-bodied male—old men, invalids, youths and unattached women—are provided for either by plots on the old sites of cultivation or in some neighbouring forest land; a similar arrangement is made for men who wish to cultivate land additional to the prescribed allotment.

The necessary movements of population, whether to sites within walking distance of the original settlement, or in extreme cases to an entirely new district, have been made, we are assured, by persuasion, without the application of sanctions, and have even been accepted with gratitude. It is essential, nevertheless, that operations should be covered by administrative order.

Some of the blocks have extended to dimensions of 1,500 to 2,000 hectares or more, and care is exercised in their arrangement to avoid the creation of spaces in the general forest cover wide enough to affect its permanence. As a detail, the use of cassava is ingenious. It is employed in the first year to fill gaps in the stand of rice, and extended over the plot when the rice has been reaped; when rice is replanted in the following rainy season, the cassava shoots are removed, leaving the roots to resume occupation after harvest. Finally, cassava provides a cover pending the development of the woody plants forming the secondary forest growth which takes over for the duration of the resting period. By these means the exposure of the soil between crops is reduced to a minimum.

The author discusses the administrative, social, and agricultural problems involved in the scheme described, and the objections that can

be raised. The degree of regimentation required is at first sight repellent, but under present conditions there are many areas where direction is plainly necessary in the natives' own long-term interests. Where " development " and the maximum production of export crops are accepted as desirable, it is essential. A stable, adequately nourished community, with a permanent agriculture, provides a foundation for progress otherwise unattainable.

In conclusion, we reproduce the author's view of the great importance of the inclusion of cotton in the scheme. " It constitutes the cash crop, and provides the motive power for the whole cultural organization, ensuring that the other crops are established in due course on a sufficient area. The exercise of this function is best illustrated by the periodic demands for provisions made on the cotton-growing areas by those in other districts who, lacking this stimulus, fail to cultivate an area sufficient for their own requirements."—ED.

THE DESIGN OF EXPERIMENTS. By Dr. R. A. Fisher, F.R.S. (Oliver and Boyd, Ltd., Edinburgh. 1947. 4th Ed. Price: 12s. 6d.) Those who wish to keep abreast of modern thought on the use of statistics in experimental work, regard a new edition of either of R. A. Fisher's books on the subject as necessary reading. It does not follow that the non-mathematicians among us always find them easy reading. Both " The Design of Experiments " and " Statistical Methods " are full of strong meat, to be assimilated only slowly by those with delicate mental digestions. Nevertheless, the basic principles on which sound experimental design depends, are easily grasped, even by those who are defeated by the algebra involved in their application. This is admirably illustrated by the discussion of the lady with the cup of tea.

New editions are required of both these books at regular intervals. The reviewer believes that a redistribution of matter between them would be a help to most investigators. He would like to see " Design " limited to the principles underlying the science of asking intelligent questions, and " Methods " devoted to the planning and analysis of experiments. In this way, the importance of properly framed questions, on which Fisher has always insisted, would receive its proper emphasis. Those who find higher algebra heavy going would have " Design " for their guide to principles, and " Methods " for reference on the conduct of experiments.—J. B. H.

CORRESPONDENCE

ON THE GRADE AND STAPLE OF COTTON

(The following letter has been received from Mr. R. G. Saraiya, Vice-President of the Indian Central Cotton Committee. Mr. Lord's letter in reply is also printed.—Ed.)

NAVSARI CHAMBERS,
OUTRAM ROAD, FORT,
BOMBAY.
October 29, 1947.

SIR,

I have read with considerable interest the article "On the Grade and Staple of Cotton," by Mr. E. Lord, in your issue of July 1947. As the article supplies a good deal of information, I am tempted to make a few suggestions with a view to making the information even more comprehensive.

Perhaps the most controversial issue in cotton circles is that of staple length. It is either a conception or an average, but in any case, opinions differ strongly about it. On page 191, an attempt is made in the article under reference to correlate the results of laboratory tests with American standards, presumably as judged by cotton classers employed by spinners or the trade. It is said, "It has been found that a good estimate of American staple may be obtained from the quantity 'effective length,' determined from sorter diagrams by multiplying by 0·91." It is necessary here to define what is meant by "effective length" which is determined from sorter diagrams. Is it the "arithmetical mean" of fibre lengths or is it the "mode"? Perhaps the "effective length" has been defined in the publications of Shirley Institute, and it will be of interest to cotton traders and breeders all over the world if the "effective length" is explained and its relation to the "mean" or "mode" found by the Balls or Baer sorter is worked out. We in India have similar problems of reconciling staple lengths as found by the Technological Laboratory of the Indian Central Cotton Committee, with the staple lengths as judged by the Trade. The Technological Laboratory of the Indian Central Cotton Committee here expresses the "arithmetical mean" of the fibre lengths found by the Balls and Baer sorters, and the difference between this "mean" length and trade estimate of the staple length is not so large as $\frac{3}{32}$ in. but smaller, say, $\frac{1}{32}$ in. or $\frac{1}{16}$ in., the laboratory result of the staple length being higher.

In the description of Indian cotton standards, latest developments have not been mentioned by the author. The East India Cotton Association is now preparing standards of staple lengths for the last five years. The basis of the Indian Cotton Contract now is fine Jarilla $\frac{7}{8}$ in. staple, and the East India Cotton Association has prepared standards of Jarilla cotton ranging from $\frac{11}{16}$ in. to $\frac{7}{8}$ in. The conception of "fair staple" and "good staple" mentioned in the article has now

given place to the description of definite staple lengths in so far as the bulk of the Indian cotton crop is concerned. Only in regard to Deshi cotton, like Bengals, has no definite staple length been mentioned. Even in regard to the Central Provinces' Oomra cotton, the Government of India have recently announced definite " ceiling " prices for cotton ⅞ in. in staple, and announced higher " ceilings " for longer staple. Indian cotton is, therefore, now sold by type or " growth," grade and a definite description of staple lengths.

Yours faithfully,
R. G. SARAIYA.

SHIRLEY INSTITUTE,
DIDSBURY,
MANCHESTER.
November 27, 1947.

SIR,

Mr. R. G. Saraiya raises a number of pertinent points in his letter, and in connection with these the following may be of interest.

The quantity " effective length " is determined from sorter diagrams by a simple geometrical construction designed to give a measure of length virtually independent of the presence of a small proportion of excessively long fibres, or of a long tail of very short fibres. This quantity has been in constant use at the Shirley Institute for some considerable time and its determination is described in a paper by Miss G. G. Clegg (*J. Text. Inst.*, 1932, **23**, T35-54). Compared with other characteristics of fibre length distributions, the effective length is generally somewhat longer than the " mode " and appreciably longer than the " arithmetic mean." The effective length is closely related to the optimum roller settings required on the various speed and spinning frames, and on the basis of this property it was given its name.

In a paper on " The Staple Length of Cotton " (E. Lord, *J. Text. Inst.*, 1942, **33**, T205-240), a full discussion is given of the relations between the Official American Staple Length Standards and the various characteristics of sorter diagrams, the analysis being based on the results of tests made on actual standard type samples. In the American classification it was found that where a pronounced " mode " or most frequent length exists in a sample of cotton, then, on the basis of the Official Standards, the cotton is given that value for its staple length. Unfortunately, however, the mode cannot be found with a high degree of precision, and indeed may be quite indeterminate if the sample is very irregular in length. Consequently, the mode is not a wholly suitable measure for defining staple length. There are also objections against the use of the arithmetic mean in estimating staple length. The value of the mean is greatly influenced by the proportion of short fibre in a sample, whereas staple length (determined by hand pulling) is found to disregard excess short fibre. By its method of construction the effective length is insensitive to marked changes in the proportions of very short fibre, and consequently it provides a measure which is typical of the bulk of the longer fibres (although ignoring those of extreme length) in a sample. It is this property which makes the effective length more closely related to American staple length than

either the mode or the mean. Space forbids entering into further details, but it may be added that the rule

$$(\text{effective length}) \times 0{\cdot}91 = (\text{American Staple})$$

is a generalization derived from the results recorded in the second paper referred to above and of more recent tests. This paper also contains details of the results of a survey made to investigate the current practice of hand stapling in British commercial and mill practice.

Many readers, particularly spinners, will be most interested in Mr. Saraiya's references to recent developments in connection with staple standards for Indian cotton. This question was not touched upon in the original article in this Review, mainly because these standards do not yet affect the classification of much of the crop, and also because they are not yet in effective use in this country.

When use of the Indian staple standards becomes firmly established, and particularly if they become extended over the whole of the crop the sale of Indian cotton on the basis of staple length as well as type and grade will be of great help to the spinner in maintaining even-running supplies for mill use.

Yours faithfully,
E. Lord.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA

1. Supply and Distribution of the Various Types of Indian Cotton during the Season 1944-45. (*Stat. Bull.* No. 15. Ind. Cent. Cott. Comm., 1947.) A review of the 1944-45 season is followed by statistical and other information concerning: Area under improved varieties of cotton from 1942-43 to 1944-45; supply and distribution of the various types of Indian cotton during the twelve months commencing September 1, 1943 and 1944; the Indian cotton crop of 1944-45 classified according to staple length; stocks of Indian cotton held on August 31, 1945, by the mills and the trade in Madras Province; exports. The various appendices deal with: Bombay average prices for Broach, 1930-31 to 1944-45; Indian cotton crop classified according to staple length, 1930-31 to 1944-45; stocks of Indian raw cotton held on August 31, 1941 to 1945, by the mills and the trade in India; receipts at mills in India of raw cotton classified by varieties, 1935-36 to 1944-45; Indian raw cotton* consumed by Indian States and Indian mills, 1935-36 to 1944-45; exports by sea of Indian cotton classified by varieties, 1935-36 to 1944-45; exports of Indian cotton, and prices, 1935-36 to 1944-45.

2. Indian Cotton Statistics. We have received from the Indian Central Cotton Committee copies of Statistical Leaflets Nos. 1 to 4, 1945-46, giving information regarding the following: The staple length of Indian cotton of the 1945-46 season, and the districts in which grown; stocks of Indian raw cotton held by the mills in Bombay Island, Karachi, and the rest of India, on August 31, 1945 and 1946; receipts at mills in the various Provinces, of Indian raw cotton classified by varieties, 1945-46 season; exports of Indian raw cotton, classified by varieties, to Europe, United Kingdom, China, and Japan, 1945-46 season.

3. The Improvement of Statistics of Cotton Production in India. By V. G. Panse and G. C. Shaligram. (*Ind. Cott. Grwg. Rev.*, **1**, 3, 1947, p. 119.) In this article the application of the random sampling method for estimating annual yield of cotton and for giving reliable normal yields and yield forecasts is illustrated by a description of the large-scale yield surveys, based on this method, now in progress in the Central Provinces. The organization of the surveys has been developed in such a manner that the field work can be entrusted to the departmental field staff normally responsible for crop cutting experiments.

The provincial estimate of yield obtained from the survey has a low standard error—viz., between 2 and 3 per cent. The standard errors of the district estimates range from 5 to 7 per cent., which may be regarded as a sufficient level of accuracy for determining normal yield with a high precision by averaging the annual estimate for a district over a series of seasons. Ten-yearly moving averages are suggested for this purpose. District estimates of yield obtained over a period of three to five years in the surveys indicate that the present normal yields in the province are too high. The procedure employed for obtaining yield forecasts can be calculated at the proper time when official forecasts are issued, and are more accurate than those obtained by the present method. The kind of ancillary information that can be secured through the medium of the survey is illustrated. The need for the establishment of statistical sections under trained statisticians to deal with yield surveys and other agricultural statistics is emphasized.

4. Indian Cotton: Improvement. (*Ind. Text. J.*, **57**, 1947, p. 330. From *J. Text. Inst.*, xxxviii, 6, 1947, A250.) Cotton researches conducted in India with a view to minimizing imports of long-staple cotton, and at the same time improving the quality produced in India, are reviewed. Experiments carried out in Sind, the

Punjab, and the Central Provinces are briefly described. A promising Perso-American cotton has been evolved in the United Provinces, and considerable advances have been made in the Mysore State relating to the growing of Egyptian cotton.

5. Plant Breeding and Genetics in India. By R. H. Richaria. (Patna Law Press, Patna, 1945. Reviewed *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 349.) The enthusiasm with which Indian plant breeders and geneticists have thrown themselves into the task of improving their country's crop plants has led to the publication of so many articles that a review summarizing their achievements to date is very timely. The author has attempted this onerous task, and has produced a concentrated book of some four hundred pages, summarizing the work done on the various Indian crops, including fibres, cereals, oil seeds, leguminous plants, fruit crops, vegetables, sugarcane, medicinal plants, forage crops, etc. Summaries are given of the genetical and breeding work carried out in India. A useful list follows of improved varieties of the more important plants, and a bibliography concludes each section. At the end of the book a short bibliography on vernalization, a list of miscellaneous references, and a list of improved cotton varieties that appears to have strayed from its proper place, are appended. For plant breeders in India and elsewhere, Dr. Richaria's book will find its principal use as a reference book, for the author has gone to great pains to make his bibliographies as complete as possible, including many of the official publications of Indian Agricultural Departments, which often contain useful information unpublished elsewhere. As a guide to Indian plant breeding, however, the book suffers rather from extreme condensation and a somewhat hurried and uncritical presentation, which tends to allude to information rather than unfold it. The lists of improved varieties are very useful, also the vernacular names of the crops. It is a pity that the latter were not included in the index, for Indian names of crops are a source of great trouble to readers of Indian scientific literature from other countries.

6. Indian Handloom Industry: Economics. By V. G. Ramakrishnan. (*Ind. Text. J.*, **57**, 1947, p. 312. From *J. Text. Inst.*, xxxviii, **6**, 1947, A291.) Figures are presented to show that the handloom industry in India is not in a depressed condition. The handloom has its place in the economy of the country so long as it is confined to those lines in which mills do not as a rule compete. It is stated that the handloom can survive side by side with the mill industry, and continue to give employment to as many people as before. The regulation of the relation of these two types of textile industry requires to be considered by the Government of India.

7. Bombay Cotton Annual, 1945-46. (The East India Cotton Assn., Ltd., Bombay. Price: Rs. 3.) This is the usual authoritative compendium of all matters relating to every branch of the cotton trade. The first section contains the Twenty-fifth Annual Report of the Directors of the East India Cotton Association, Ltd., for the 1945-46 season. This is followed by numerous statistical tables of acreage, production, ginning returns, imports, exports, consumption, stocks, prices, and textiles; Government notices, etc. The publication should meet the requirements of all who are interested in the production, distribution and consumption of Indian and foreign cottons, yarn and cloth.

8. Cultivation of Jayawant Cotton in the Bombay Province. By V. C. Pavate. (*Ind. Frmg.*, vii, **9**, 1946, p. 392.) Jayawant (Victorious) cotton was evolved in 1922 from Dharwar cottons in the Bombay Province. It thrives well on soils where Dharwar cotton was formerly grown. It is a white cotton of staple length from $\frac{7}{8}$ to 1 in., and is suitable for 36 counts. The ginning percentage varies from 28 to 30. The cultivation of this cotton and schemes for the multiplication and distribution of its seed are described.

9. Bombay: Cotton Improvement in South Gujerat. By G. B. Patel. (*Ind. Cott. Grwg. Rev.*, **1**, 1, 1947, p. 19.) An account is given of the soils and climatic conditions, the crop rotation practised, the history of cotton in the tract from 1884, and the research work carried out to evolve types of cotton with satisfactory yield and high ginning percentage.

10. Spinning Test Results on Indian Cottons, 1946-47. By D. L. Sen. (*Tech. Circs.*, Nos. 692, 693, 695-703. Ind. Cent. Cott. Comm., 1947.) The circulars contain the grader's report and spinning test results for Gaorani 6, Malvi, Suyog (Seg. 8-1), and Westerns (Anantapur) cottons for the 1946-47 season, and the report of the Standards Committee and spinning test reports for C.P. No. 1, Jarila (Berar), Jarila (East Khandesh), Jarila (West Khandesh), P.A. 289F/K25 (roller-ginned and saw-ginned), and Verum cottons for the 1946-47 season.

11. Indore Institute of Plant Industry: Progress Report on Cotton Research, 1945-46. In tests carried out with Bhoj cotton (Dhar 43) in comparison with Malvi 9, Jarila, and Local cottons the results showed that Bhoj cotton gave significantly higher yield than Local and Malvi 9, but the difference between Bhoj and Jarila was not significant. In maximum halo length Bhoj cotton and Jarila did not differ significantly from Local, but were significantly better than Malvi 9. In ginning percentage Malvi 9 and Jarila were significantly higher than Bhoj and Local. The low yield of Malvi 9 was due to poor germination of the seed.

In a varietal trial on wilt-free land three progeny bulks, Nos. 13, 14 and 16 (Malvi 9 × Jarila), from the Genetics and Botany Section, and M9-20 × Jarila, a selected progeny bulk from the Plant Breeding Section, were tried against Bhoj, Jarila, Malvi 9 and Malvi 9-20 cottons. There were no significant differences among the varieties for yield of kapas per acre. Jarila had significantly higher maximum halo-length than the remaining varieties. Differences among the varieties for ginning out-turn were not significant. In a varietal trial on wilt-infected land five progeny bulks, 4, 13A, 16A, 21 and 22 (Malvi 9 × Jarila), in addition to the four, 13, 14, 16 and M9-20 × Jarila, tried on wilt-free land, were tested against Bhoj, Jarila and Malvi 9. In yield of kapas 16A, though not differing significantly from progeny bulks 13A, 14, Jarila and M9-20 × Jarila, was significantly higher than the remaining strains. Progeny bulks 21 and 22 were significantly poorer than all strains except Malvi 9, which gave the lowest yield. In maximum halo-length, progeny bulks 16, 4, 14, 22, M9-20 × Jarila and 13A were significantly superior to progeny bulks 16A, 21, Bhoj and M9 cottons. Malvi 9 was again significantly poorer. In ginning out-turn the differences were small but significant.

12. The Chemical Processing of Indian Cotton Materials. II. By N. Ahmad *et al.* (*Tech. Bull. Ser. B.* No. 35. Ind. Cent. Cotton Comm., 1946.) Discusses the influence of different concentrations of caustic soda on the quality of kier boiled and bleached yarns spun from Indian cottons.

13. Cotton Jassid in the Punjab. By Afzal and Ghani. See Abstract 69.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

14. AFRICA. Kenya: Some Experiments in Native Agriculture in the Elgeyo-Marakwet District. By J. B. Carson. (*E. Afr. Agr. Jour.*, xiii, 1, 1947, p. 34.) Everything done in this district during the past few years has had the objective of laying foundations for a big expansion of work when staff and funds become available. The main lines of work have been experiments with new crops, seed-bulking, and propaganda to introduce a crop rotation with special emphasis on legumes. Large-scale attack on a few easily defined objectives seems to have proved more profitable than diffused efforts on a large number of more detailed schemes. It is easier to popularize something of which the good points are obvious than something which yields only obscure or long-term benefits; for example, *Kigutu* grass is easier to introduce for general planting as a wash stop than *Paspalum notatum*, because of the former's additional value as a thatching grass. The people are naturally lazy; therefore a crop that is easy to look after and harvest can be more easily popularized than a difficult one. They are conservative; therefore a better variety of a well-known crop, such as "Dobbs" sorghum, has a stronger appeal than something strange. Native likes and dislikes need to be studied; they cannot always be followed, but when practicable should be considered, for it is

easier to get the people to plant something they like, or at least tolerate, than something they heartily detest.

15. NIGERIA: COTTON INDUSTRY, 1946-48. (*Half-yearly Report to June*, 1947.)

Northern Provinces, 1946-47.—Rains continued late and growing conditions throughout the season were favourable. The early onset of the harmattan led to a diminished yield in late-planted cotton in Sokoto Province, whilst some boll-shedding was reported from waterlogged soils in Zaria Province. 5,816 tons of seed had been distributed in 1946 compared with 4,349 tons in 1945. Increased planting was evident in all the main growing areas, and production was expected to be well above the figures for the previous season. Purchases for export were, however, disappointing, the total of 32,600 bales being 1,100 bales less than in 1945-46. One cause of the lower exports was the scarcity of imported cotton goods, and the consequent keen demand for cotton by local spinners and weavers, with the result that the export purchases suffered in markets within easy reach of the established textile centres. A more serious factor, however, must be taken into account. Previously unrecorded in the Northern Provinces, the pink bollworm was found in last year's crop; this year it has for the first time assumed serious proportions. Reliable estimates of the losses incurred are not yet to hand. Samuru (Zaria) cotton was found to have a 6 per cent. infestation as early as December 1946; larvæ were observed in a South Katsina market in January; and the pest appeared in large numbers at all ginneries throughout the whole of their working period. In view of the serious losses pink bollworm has caused in other cotton-growing countries immediate action is necessary. Measures have been taken to enforce the uprooting and burning of old cotton stalks and the sunning of seed before planting; the installation of heaters to treat planting-seed at all ginneries has also been strongly recommended. The growing piles of old seed awaiting transport from the ginneries constitute a very serious focus of infestation for new seed.

Seven ginneries were operated by the British Cotton Growing Association during the season. The ginning percentages were generally higher than in the previous year.

The Botanist's selection, Samuru 26C, was again multiplied for distribution at Daudawa, and again showed marked superiority over ordinary Allen in respect of lint index.

Western Provinces, 1946-47.—The crop was exceptionally poor during the 1946-47 season, with the result that the only cotton graded was at Meko. The increasing demand for local weaving absorbed the whole of the crop from other districts, and the prices were, in many cases, double those offered for export. Meko cotton was of satisfactory quality, but seed cotton marketed locally was of very poor quality, being dirty and stained. The fact that the market for cotton for local consumption is willing to pay a high price for it is likely to have an adverse effect on quality offered for sale for export in future years.

1947-48 *season*.—In Oyo and Abeokuta Provinces germination of the new seed already planted is good. In between the harvesting of the previous crop and the distribution of seed for the 1947-48 season intensive propaganda was carried out to encourage uprooting and burning of the old cotton plants to prevent infestation by pink bollworm. In general, there has been little response to the propaganda.

16. NYASALAND: COTTON INDUSTRY, 1947. (*Cott. and Genl. Econ. Rev.*, 14/11/47.) The revised estimate of the crop is 4,170 short tons of seed cotton, 3,801 tons of which had been purchased by the end of October. Buying continues on the Lower River, and it is now certain that even the present estimate of 3,860 short tons will be exceeded; the crop has been well graded, and is of good quality, containing a high percentage of good clean cotton. In the rest of the Province all markets have now been closed, and the uprooting and destruction of plants completed. The total purchases were 318·3 short tons. In the Central Province all markets were closed by the end of the month, and total purchases were 325 short tons. Adverse weather along the Lake shore affected the crop more severely than was

thought at the time. Growers were pleased with the prices, and it now appears probable that there may be some increase in cotton production next year. Bad communications again hindered the movement of the marketed crop and of seed, and both suffered considerable damage in consequence.

17. SOUTHERN RHODESIA: COTTON INDUSTRY. (*E. Afr. and Rhod.*, 9/10/47.) In a recent broadcast on Southern Rhodesia Sir Miles Thomas stated that a big contribution is being made to the native welfare by the development of the cotton industry. From the research undertaken by Major Cameron and his team of scientists into the best type of cotton plant to foster, right through to the spinning and weaving mills in Gatooma and Buluwayo, there is an atmosphere of efficiency and commercial effectiveness that is impressive. Already the spinning capacity has been raised from 3,800 spindles to 17,000 in Gatooma, and in Buluwayo shirts and vests for natives are being sold retail at round about three shillings apiece. This means better health and a fuller appreciation of worth-while comforts to the Africans as they become more enlightened and understanding.

18. THE SUDAN: A RECORD OF PROGRESS, 1898-1947. (Printed by the authority of the Sudan Government, 1947. Price 6d.) An authentic account of the progress made during the period under review. Under the various chapter headings much valuable information is included on the following subjects: (I) *Administrative and Judicial Systems.*—The establishment of local courts; the development of local self-government; the establishment of State Courts. (II) *Sudanization.*—The intention of the Sudan Government to appoint qualified Sudanese to vacancies in the public service. (III) *Education.*—The progress achieved in the Northern Sudan by the establishment of village, elementary, intermediate, and secondary schools. The establishment of the Gordon College for the development of higher education. The development of education for girls. (IV) *Agriculture.*—The completion of various irrigation schemes for the improvement of water supplies to Egypt, and the inauguration of irrigational developments in the Sudan. The establishment of a Soil Conservation Board working in close association with the Department of Agriculture and Forests. The progress of the research work at the Gezira Research Farm, Wad Medani. The establishment of a higher school of Veterinary Science. (V) *Land Tenure.*—The dual aim of the lands policy of the Government to protect the reasonable interests of the native proprietors, and to develop the land for agricultural and building purposes.

Detailed information is also given in the book in connection with economics and trade; public finance; communications; public health; security and defence; plans for the future. A table of notable dates in the history of the Sudan is also included.

19. THE ROLE OF PASTURE DEVELOPMENT IN SOIL CONSERVATION, TANGANYIKA TERRITORY. By H. J. van Rensburg. (*E. Afr. Agr. Jour.*, xiii, **1**, 1947, p. 23.) The serious nature of soil erosion problems in Tanganyika Territory is emphasized. Soil-conservation measures which can be fitted into different farming systems are discussed. These measures are to a large extent based on protection for the soil in the form of entire or partial grass cover. The importance of making as much use as possible of local material and indigenous plants is stressed. The measures which are advocated are cheap, and many of them involve little or no effort. They are based upon sound and proved soil conservation and farming practices, and have already been found to be effective in the field.

20. UGANDA: COTTON INDUSTRY, 1947-48. (*Report from Dept. of Agr.* 22/10/47.) Weather conditions in September were favourable in all zones and, in consequence, the late plantings established well and the earlier plantings made good growths. The crop is healthy and the incidence of pests and disease is normal. Crop prospects are at present satisfactory, and in the Eastern and Northern Province zones a normal crop is anticipated. In Buganda and Bunyoro Province zones, provided that rainfall continues to be adequate for the late plantings, average yields should be obtained, but as the bulk of the acreage is late planted, it is anticipated that total production will be lower than that of last season.

21. AUSTRALIA. THE CURRENT COTTON SITUATION, 1946-47. (*Proc. Int. Cott. Adv. Comm.*, June 9-11, 1947.) Australian mill consuming capacity for cotton is currently estimated at around 100,000 bales annually. Actual consumption in 1946-47, however, may not exceed 60,000 bales owing chiefly to shortage of textile workers. Practically all the cotton consumed by Australian mills is imported, since cotton production has shown a considerable reduction during recent years. The principal sources of imported cotton are the United States, Egypt, India, Belgian Congo, East Africa, and Brazil. Drought, labour shortages, and favourable prices for competing crops have been largely responsible for keeping cotton production during the last three years at only one-fifth of the pre-war (1935-39) average.

22. QUEENSLAND COTTON INDUSTRY, 1946-47. (*Cott. and Genl. Econ. Rev.*, 7/11/47.) A report from the Cotton Marketing Board, dated October 9, states that the 1946-47 Queensland cotton season is now nearing completion and it appears that the total production of raw cotton will be less than 2,000 bales. The severe drought conditions prevailing during the planting period in 1946 delayed planting and in numerous cases prevented farmers from planting at all. For the coming season the Cotton Marketing Board has launched a campaign to increase the acreage planted to cotton to 30,000 acres, this acreage to be increased each year following. In normal conditions in Queensland 30,000 acres should yield about 6,000 bales of raw cotton. Excellent rains have fallen recently, averaging 4 inches in most cotton-growing areas, and conditions are ideal for the sowing of the crop for the coming season. Government is taking more interest in the cotton industry and in the possibility of putting cotton on a more stable basis under irrigation culture. It is being realized that the cultivation of much larger acreages of this crop is very necessary to the economy of Queensland, and is in line with the policies of the governments of Great Britain and the Dominions in the conservation of dollars.

A new British spinning mill will commence operations in Brisbane in the early part of 1948, and its requirements are stated to be 1,100 bales of Queensland raw cotton for that year, with increasing amounts in the years following. There is an existing market in Australia at the present time for over 100,000 bales of raw cotton, and the spinning industry is rapidly developing there. This will be the only cotton spinning mill in Queensland, the bulk of the mills being in Sydney and Melbourne. The labour shortage during the war years and the necessity for increased food production—for which much higher returns were paid to the producers—caused the cotton industry to suffer badly, and the Cotton Marketing Board is now faced with the task of rehabilitating the industry.

The General Manager of the Board is in the United States investigating the various aspects of the cotton industry, particularly in regard to ginning methods, the new International Harvester cotton picker, oil processing, and solvent extraction, with a view to improving methods in use in Australia. Two Rust cotton pickers are already in operation in Queensland, and one I.H.C. picker is being imported for use in the coming season. It is anticipated that the Commonwealth Government will announce shortly an increased price to cotton growers, which will be an incentive to much higher cotton production in the State, and the price for cotton will be comparable with other primary products.

23. THE STATUS OF HEAT TREATMENT OF PLANT COTTON SEED FOR THE CONTROL OF PINK BOLLWORM, *Pectinophora scutigera*, HOLD., IN QUEENSLAND. By W. S. Sloan. See Abstract 78.

24. WEST INDIES. BARBADOS: COTTON INDUSTRY, 1945-46. (*Ann. Rpt. Dpt. of Sci. and Agr., Barbados*, 1945-46.) The area planted to cotton for the season was 150¾ acres, of which 16 were grown by plantations and 134¾ acres by peasants. The total yield of seed cotton amounted to 37,002 lb., made up of 6,554 lb. of plantation cotton and 30,448 lb. from peasants. The average yield per acre for plantation and peasants' cotton was 410 lb. and 226 lb. respectively. The ginning

percentage for the Island's crop, as recorded by the Barbados Co-operative Cotton Factory, was 26·7.

Work was continued during the season with the selfed seed of the bulked cotton obtained from the thirteen selections of the 1944-45 plots grown at Codrington Experimental Station in a variety trial with B.1 as standard. Nine of these have been selected on yield of seed cotton per acre and ginning out-turn, and will be grown in a further variety trial next season; they are B.4401, B.4402, B.4403, B.4404, B.4406, B.4407, B.4410, B.4411 and B.4413.

A second variety trial was conducted at Codrington Experimental Station which included selections of the B.40, B.41, B.42, and B.43 Series with B.1 as standard. The strains retained were B.4001, B.4111, B.4204, B.4212, B.4301, B.4306, B.4308, B.4309 and B.4310. As soon as the results of the experiment have been analysed, the best of these strains will be retained for inclusion in a further trial with selections from the B.44 Series and the standard B.1. For the seventh year in succession, no pink bollworm was found and for the encouragement of cotton growing, the cotton close season has been shortened and the planting date for cotton advanced to July 1. *Alabama argillacea* was in most cases kept under control by spraying with lead arsenate.

Fifty bales of stained cotton lint, to be used in connection with the Experimental Spinning Plant, were examined, and as no cotton pests were found they were admitted. No shipments of cotton seed or cottonseed meal arrived in the Colony during the year.

25. JAMAICA: COTTON MILLS. (*Crown Col.*, August, 1947, p. 446.) The Ariguanabo Cotton Mills of Cuba hold a major interest in the new company which is negotiating a franchise with the Government for the erection of mills, with a capacity of 10,000,000 yards per annum, to produce brown calico, blue denim, and blue chambray here. A local company is a partner in the venture, which will be capitalized at £400,000. The mills will support a new company also, which will produce starch in considerable quantities for textiles.

COTTON IN THE UNITED STATES

26. RESEARCH TRENDS IN PLANT BREEDING IN THE UNITED STATES. By E. Aberg, (In Swedish. *Arsb. Jordbruksforskning*, Stockholm, 1946, p. 97. From *Pl. Bre. Abs.*, xvii, 3, 1947, p. 274.) Aims, and especially methods, in American plant breeding are described in this review.

27. ARIZONA: BEEKEEPING NEAR COTTON FIELDS DUSTED WITH D.D.T. By S. E. McGregor and C. T. Vorhies. (*Bull.* 207. Arizona Agr. Exp. Sta., 1947.) The results of the experiments reported indicated that treatments of large cotton acreages by airplane with insecticidal dust containing 10 per cent. D.D.T. in pyrophyllite at 15 lb. per acre, 5 per cent. D.D.T. in sulphur at 20 lb. per acre, or a spray containing 1½-3 lb. D.D.T. dissolved in xylene per acre, were not hazardous to commercial beekeeping.

28. FLORIDA: COTTON FERTILIZER EXPERIMENTS, 1945-46. (*Ann. Rpt. Agr. Exp. Sta., Fla.*, 1945-46.) Co-operative fertilizer experiments with field crops were conducted for the purpose of testing the best crops and practices directly under field conditions in different parts of the State. Mobile Unit No. 1 operated in Leon, Jefferson, and Madison counties; No. 2 in Escambia, Santa Rosa, and Okaloosa counties; No. 3 in Jackson, Calhoun, Washington, and Holmes counties. The results were as follows: *No.* 1. Of the eight varieties tested, the highest yields of seed cotton were obtained from Coker's 100 Wilt Strain 4, Stonewilt Strain 5, and Victory Wilt Strain 3. These varieties likewise had the highest lint value and wilt resistance. *No.* 2. For two years in succession Stonewilt, Coker's 100 Wilt Resistant and Cleveland Wilt Resistant varieties (staple length approximately 1 in.) produced higher yields of seed cotton than semi- or non-wilt-resistant types of cotton. Cotton fertilizer tests were conducted on Red Bay, Magnolia, and Norfolk fine

sandy loam soils from which peanuts were harvested in 1944. Results indicate that 400 to 600 lb. of 4-10-7 plus 100 to 150 lb. of nitrate of soda should be applied to cotton following harvested peanuts. *No.* 3. In two variety tests the highest yield of seed cotton per acre was made by Coker's 100 Wilt Strain 4, with 1,129 lb., followed in succession by Stonewilt, 1,061 lb., Cleveland Wilt Resistant Strain 4, 989 lb., Stoneville 2B, 926 lb., Cook's 144, 896 lb. and D.P.L. Strain 14, 689 lb. Results of three cotton fertilizer experiments following harvested peanuts on Marlborough, Norfolk, and Ruston soils indicated that a complete fertilizer relatively high in potash should be applied to these soils where cotton follows a harvested crop of peanuts.

29. GEORGIA: EMPIRE COTTON. (*58th Ann. Rpt. Ga. Exp. Sta.*, 1945-46. Received 1947.) Tests conducted in 1944 and 1945 under severe wilt conditions have shown that a number of strains of Empire cotton are highly resistant to cotton wilt. These wilt-resistant strains are being multiplied as rapidly as possible—approximately 600 acres having been planted for seed multiplication purposes in 1946. A limited amount of wilt-resistant Empire seed will be available for distribution in 1947, and by 1948 it is expected that all seed released to the public will be wilt resistant. In 1945 wilt-resistant Empire was tested at five locations in the Coastal Plain section of the South-eastern States. The average yield at these five locations was 458 lb. lint per acre, compared with 459 lb. per acre for Coker 100 Wilt, 429 lb. for Stoneville 2B, and 421 lb. for Deltapine 14. These results indicate that Empire should be satisfactory for cultivation under Coastal Plain conditions. Tests carried out with this cotton at a number of locations in several States in which it has not previously been grown have given favourable results, and widespread interest in the variety has developed.

30. LOUISIANA: COTTON SELECTION WORK, 1944-45. (*La. Agr. Exp.*, 1944-45. From *Pl. Bre. Abs.*, xvii, 3, 1947, p. 276.) Selections of Stoneville 2B and Dixie Triumph × Deltapine were tested for wilt resistance. The inheritance of reaction to wilt was investigated. Selection of Hopi crosses resulted in the production of strains with improved boll size, some of which possessed very strong fibre. Progenies of Stonewilt × Hopi and Deltapine × Hopi showed the most promise. Strains 55 × 829-47-3-7-9 and 55 × 829-33-2-9-10, derived from the cross D and P.L. × Dixie Triumph, were to be increased for release in 1947.

31. MISSISSIPPI: *Thielaviopsis* ROOT ROT OF COTTON. By J. T. Presley. See Abstract 90.

32. PENNSYLVANIA: RESEARCH AT THE SOUTHERN REGIONAL RESEARCH LABORATORY. By H. T. Herrick. See Abstract 61.

33. SOUTH CAROLINA: COTTON PRODUCTION. (*Peacetime Frmg. in S. Carolina*, 1946.) The effect of the boll weevil, which spread over the State in the early 1920's, followed by the low prices for cotton that came with the economic depression of the 30's, resulted in a decrease in the cotton acreage from an average of 1,962,000 acres for the five-year period 1921-25, to an average of 1,094,000 acres for the five-year period 1941-45, a decrease of 44 per cent. During this same period, however, by the cultivation of improved varieties, closer spacing, more efficient use of fertilizers, improved cultural practices, and methods of boll weevil control, the average yield of lint cotton was increased from 181 lb. per acre during the 1921-25 period to 323 lb. in the 1941-45 period, an increase of 142 lb. lint cotton per acre. . . . Great progress was also made in improving the quality and length of the staple to meet market demands. Reliable estimates indicated that in 1925 less than 20 per cent. of the cotton produced in South Carolina was of $\frac{15}{16}$ in. or longer. A survey of the extensive cotton mill industry in the State showed that mills were mainly using cotton of 1 in. staple or longer, and, consequently, cotton used for manufacture in the mills was being obtained from other cotton-producing areas, and the cotton grown in the State was going elsewhere to be used. Farmers appreciated the situation, and efforts were made to obtain and grow varieties of the staple length required, with the result that the staple length gradually im-

proved until 96·4 per cent. of the 1946 crop was 1 in. or longer. In addition, the average yield of lint cotton of 360 lb. per acre for 1946 was the third highest on record.
34. TEXAS: AMERICAN COTTON, NEW VARIETIES. (*Cotton*, M/c., 20/9/47.) A report from Corpus Christi, Texas, dated August 21, states that twenty-five varieties of cotton are growing in a test plot there. This is the eleventh year of experimentation, and to the usual varieties have been added five new types—Arkot No. 1, Acala 1517, a new Stoneville variety, Dortsch Supreme, and Northern Star. The cotton is being grown on the George Brittain farm.

COTTON IN EGYPT

35. EGYPT: COTTON PROSPECTS, 1947-48. (*Cotton*, M/c., 18/10/47.) In Lower Egypt, with the exception of a few cool and damp days, the weather during September helped the maturing and opening of the bolls. Damage caused by bollworm varies, in general, between 25 and 30 per cent. In the Gharbieh and Menoufieh provinces, however, the proportion of bolls attacked is higher, reaching 40 per cent. in certain districts. Picking is fifteen days earlier than last year, and can be considered completed in the south of the Delta. The yield per feddan is generally lower than that of last year; ginning out-turn is on an average superior to that of 1946. In Upper Egypt and Fayoum the temperature has been favourable during September. Damage from bollworm is insignificant. Picking is practically completed, the yield per feddan is about five to six kantars. Ginning out-turn is equal to that of last year.
36. EGYPTIAN COTTON. (*Cotton*, M/c., 1/11/47.) A report from the Alexandria Commercial Company, dated October 23, states that the cholera epidemic, although it has not yet reached really serious proportions, is unfortunately spreading, and continues to interfere with the movement of the crop, both from the fields to the ginneries and from the latter down to the port of Alexandria. A further scare also developed when two ships, which were scheduled to load a fair quantity of cotton for Europe, left the harbour leaving a great deal of their cotton on the quays, the crews concerned refusing to run the risk of coming into contact with the dock labourers, a number of whom were not inoculated. The result has been a rush for cotton on the spot and for delivery from the interior in the very near future. Prices generally have risen by about a dollar during the last four days, but spot cotton, of the grades which are chiefly in demand, commands even higher premiums and in some cases is at least a dollar more than the equivalent grade for future delivery. Because of the incidents of the two ships mentioned above, export houses are pressing and shipping their commitments as quickly as they can in the remote possibility that a difficulty may arise in obtaining freight. It is greatly to be hoped, however, that the advent of the cold weather, which is due shortly, will assist in controlling the epidemic, and the business will resume its normal course in the near future.
37. EGYPT: TRADING IN COTTON. (*Cott. and Genl. Econ. Rev.*, 21/11/47.) A report of November 13 states that trading in the Alexandria spot market continued fairly active . . . Karnak demand was excellent, and covered all qualities from FGF to EXTRA. Menoufi continued in keen request, and prices advanced sharply owing to scarcity of supplies. Giza 7 met with a good offtake, but offerings of Ashmouni/Zagora were abundant, and prices tended easier. . . . On the export side, some business was done with Italy and Czechoslovakia in Karnak and Ashmouni. The French GIRC continued in the market for Ashmouni/Zagora. The official British buyer maintained interest in all top qualities of both long and short staples. In addition, a number of large barter deals are being negotiated in Cairo and are expected to be concluded shortly.
38. THE EGYPTIAN COTTON GAZETTE. The contents of the second number of this journal include the following articles: "The Egyptian Section of the American Spinning Industry" (P. Ceresole); "Egyptian Cottons in India" (S. A. Kher);

"The Botanical Section" (C. H. Brown); "Cotton Spinning Tests in Egypt" (S. El Din Sadek); "Insect Pests of Cotton in Egypt" Pt. II (I. Bishara); "Mechanical Harvesting of Cotton" (H. Porter); "Developments in the European Cotton Textile Situation in 1946-47" (D. Windel). Various statistical tables are also included.

COTTON IN OTHER FOREIGN COUNTRIES

39. ARGENTINA: ALGODON. (*Sec. de Indus. y Comercio*, Buenos Aires, 1945. Received 1947.) *Bulletin Nos.* 125-126 contain the following among other articles in Spanish: "Cotton Stainer Insects: Biology" (M. A. Freiberg); "Varieties of Cotton obtained in the Country, and distributed to the Cultivators" (U. C. Garcia). Statistics are also included of acreage, production, prices, exports, etc.

40. COLLECTIVE FARMS: ESTABLISHMENT IN ARGENTINA. By R. F. Cornejo. (In Spanish. *Algodon*, Nos. 125-126, 1945, p. 355. From *Summ. Curr. Lit.*, xxvii, **18**, 1947, p. 347.) A plan is put forward for collective farming in Argentina, providing for the communal use of all agricultural equipment. The organization and internal management of such a collective farm, the division of labour, and financing are described. A plan showing initial and annual expenditure for a collective farm of 200 hectares housing 50 individuals, and a plan for the best development of such a farm are presented.

41. BELGIAN CONGO: COTTON INDUSTRY, 1947. (*Cott. and Genl. Econ. Rev.*, 7/11/47.) A report from the Compagnie Cotonnière Congolaise, dated October 30, is to the effect that the 1947 cotton crop is, in general, very satisfactory as regards quality. Staple is longer than that from the previous crop. Production of new varieties "Stoneville" and "Gar" is increasing, and now accounts for 25 per cent. of the total production, which reached 40,000 metric tons of lint, or about 180,000 running bales. . . . Several Lancashire spinners have had the opportunity to try out the new "Stoneville" variety, and have mostly found it satisfactory. . . . Congo cotton is finding a regular outlet to the local cotton industry. A cotton mill was established at Leopoldville in 1930, and during 1948 a second mill will start operations at Albertville (on Lake Tanganyika). These two establishments will together contain 40,000 spindles and about 1,200 looms. . . . For the period July 31, 1946, to August 1, 1947, exports of raw cotton totalled 44,000 tons (equivalent to 200,000 running bales). Most of the cotton shipped went to Belgium and the United Kingdom, but some was destined for Holland, Switzerland, Spain, South Africa and India. . . . Picking of the next crop in the northern parts of the Congo will begin around the end of December. Prospects are favourable.

42. LE CONTROL DE L'ÉGRENAGE ET LE CLASSEMENT DU COTON AU CONGO BELGE. By R. S. Sennitt. (*Bull. du Com. Cotonn. Congolaise*, vii, **18**, 1947, p. 47.) An interesting account discussing (1) The receipt of the seed cotton at the buying posts; (2) Transport to the ginnery; (3) The storage of the seed cotton at the ginnery; (4) Classification of the bales; (5) The work of the Ginning Controllers.

43. L'EDUCATION DES MASSES INDIGÈNES. By L. Marquet. (*Bull. du Com. Cotonn. Congolaise*, vii, **18**, 1947, p. 58.) Deals with instruction and education, the social organization, improvement of material conditions of existence, and improvement in the economic well-being of the native populations of the Belgian Congo and the education of Europeans for the purpose of carrying out the programme envisaged.

44. ÉTUDE DU SHEDDING DANS LES CULTURES COTONNIÈRES DU BAS-UÉLÉ PENDANT LA CAMPAGNE 1945. By E. E. A. Knaff. (*Bull. Agric. Congo Belge*, xxxvii, **4**, 1946, p. 813. From *Rev. App. Mycol.*, xxvi, **5**, 1947, p. 200.) A study of cotton "shedding" in the Belgian Congo, carried out in 231 fields in different parts of the Buta and Aketi areas, with particular reference to the effect upon the condition of cultural practices and attacks by insects and fungi, showed that shedding is primarily of physiological origin, though phytopathological factors may preponder-

ate. Date of sowing affects the condition in the sense that as the plants age shedding increases more rapidly than boll formation, so that production depends on the first-formed bolls. Soil factors vary in importance; as a rule, fallows of more than eight years are indicated. In clay soils thickly planted crops are least affected, while in sandy soils the reverse holds. In conclusion, it is pointed out that these observations only apply, for the present, to 1945, and it is hoped to carry out further research along the same lines.

45. Méthodes Culturales Cotonnières du Milieu Indigène dans le Bas-Uélé. By E. E. A. Knaff. (*Bull. Agric. Congo Belge*, xxxvii, 4, 1946, p. 817.) Deals briefly with the optimum date of sowing; the choice of planting site, and the density of cotton plants per are (approximately = 120 sq. yds.).

46. Brazil: Cotton Textile Industry. (*The Ambassador*, November, 1947, p. 146.) According to a recent investigation, Brazil will need to replace 80 per cent. of the equipment in its cotton textile industry if this is to be able to continue to compete in foreign markets. Much of the existing equipment is described as "cumbersome and wasteful," and there has been little replacement in recent years. The industry is financially in a strong position to carry out re-equipment. It has developed in a favourable atmosphere of cheap and abundant raw materials; cheap, trained labour; and a large and well-protected home market, particularly for the cheaper grades of fabric. . . . Mill owners have set aside reserves from recent war-time profits to cover the cost of new equipment, but the difficulty now is to obtain this. One importing firm is said to have placed orders in England for equipment valued at more than $U.S.1,000,000 when this can be delivered. Provided they can obtain the needed equipment in time to be able to compete effectively with the industries of other countries, Brazilians believe that their mills will be able to hold their own against all comers in the production of heavy cloth with a high content of raw material; they acknowledge, however, that they will not be able to compete with British mills, whose labour is more highly skilled, in the production of light and better quality articles.

47. Burma: Cotton Industry, 1947-48. (*Cott. and Genl. Econ. Rev.*, 14/11/47.) The area under cotton, according to the second official report, is 199,400 acres, as against 170,705 acres actually planted last season. The area estimated as destroyed is 9,840 acres, as compared with 26,220 acres in the corresponding forecast last year. Standing crops are in fair to good condition.

48. Chile: Production of Yarns and Fabrics. (*The Ambassador*, September, 1947, p. 150.) Expansion of the domestic yarn spinning industry in 1946, and planned enlargement for 1947, were designed to reduce Chilean dependence on foreign cotton yarns from 35 per cent. to 10 per cent. During 1946 buildings and most auxiliary equipment for two new spinning mills, with 15,500 spindles each, were completed; these were expected to increase total production by 170,000 kg. of carded yarn and 70,000 kg. of combed yarn per annum. Production of cotton yarns in the country in 1946 attained an increase of 18 per cent. above the output for 1946; spinning equipment that had been idle in several older mills, on account of the difficulty in obtaining replacements, again came into operation. Production of cotton piece-goods, on the other hand, was lower in 1946 than in 1945; this was largely due to a decline in imports of yarns. Since imports of cotton piece-goods also declined, there was an acute shortage of such textiles by the end of the year. In former years Chile obtained cheap-quality cottons from Italy and Japan, and better-quality products from the United Kingdom and United States; during 1946 supplies from all four countries aggregated a total much below the level of all pre-war imports.

49. Chinese Cotton Industry. (*The Ambassador*, August, 1947, p. 153.) The cotton textile industry is the only industry in China which seems to have enjoyed any degree of prosperity since the end of the war. At the end of 1946 the total number of spindles and looms in operation aggregated about 4,292,148 yarn spindles, 461,470 thread spindles, and 51,243 looms—about 80 per cent. of the pre-war

operating capacity. Shanghai remains the centre of cotton textile activity. Over 2,000,000 yarn spindles were in operation at the end of 1946, compared with some 750,000 at the beginning of the year; of these some 888,000 are owned by the Government-controlled China Textile Development Corporation, and 1,229,000 by private manufacturers. Next to Shanghai in importance is Tsingtao, where there are 280,000 yarn spindles operated by the C.T.D.C. and 24,000 by private concerns. Tientsin is to receive 70,000 idle spindles from Shanghai, which will augment the 299,000 yarn spindles at present being operated there by the C.T.D.C. . . . The Hunan Ti Ti Cotton Mill at Ankiang, shortly to be moved back to its pre-war site at Changsha, has 20,000 yarn spindles and 120 looms; it is reported recently to have ordered 20,000 up-to-date spindles in the U.S.A. During 1947 new spinning operations are expected to begin in Hankow (60,000 spindles), Shensi (140,000) and Chungking (60,000). Manchuria possesses 11 cotton mills. Some of the equipment of the Mukden factories has been removed by the Soviet authorities, while some has suffered damage; the North-East Production Board is now in control.

50. Combating Cotton Diseases in Szechuan. By L. Ling *et al.* See Abstract 84.

51. Cotton Production in French African Colonies: Technical Conditions. By J. Gautier. (*Coton et Fib. Trop.*, **1**, 1946, p. 35. From *Summ. Curr. Lit.*, xxvii, **10**, 1947, p. 207.) The environmental conditions necessary for successful cotton growing are discussed with respect to conditions prevailing in Africa. Agricultural practices, yield of cotton crops, and crop rotation are considered. As an example of labour requirements for the cultivation of cotton and other crops included in a complete crop rotation, a survey is made of a typical practice in Southern Sudan or Southern Tchad. The areas under the various crops which can be cultivated by a working family comprising one man, one woman and two children in different African regions are shown, and the advantages which would be gained by the introduction of mechanical equipment are fully analysed. The industrial agricultural treatment of cotton in French Africa is briefly described and the losses due to the neglected treatment of the cotton seed are pointed out. Conditions are outlined under which the construction of oil-works in Africa would be of considerable economic advantage. The economic profitability of cotton production is discussed, and it is shown that it is mainly dependent on a high yield. Interest in cotton production with respect to the cultivation of other crops of lower unit value increases with increasing distance from the coast. Buying methods which would be acceptable for African cultivators are indicated.

52. Seed Cotton in French Equatorial Africa: Testing and Selection. By R. Legendre. (*Coton et Fib. Trop.*, **1**, 1946, p. 80. From *Summ. Curr. Lit.*, xxvii, **10**, 1947, p. 213.) An account of a control system which has been introduced in French Equatorial Africa in order to maintain the quality of seed cotton. Methods of sampling and determinations of staple length, lint percentage, seed index, and percentage of healthy seeds are indicated.

53. German Textile Testing Equipment. By H. F. Schiefer *et al.* (*A.S.T.M. Bull.*, 144, 1947, p. 17. From *Summ. Curr. Lit.*, xxvii, **11**, 1947, p. 233.) A report is given of the more interesting testing methods and instruments discovered by a team of American investigators in Germany. The Schopper and the Krais single-fibre strength tests, the Schopper yarn tester, the Frenzel-Hahn universal yarn tester, and the Dietz continuous yarn tester are described. Fabric testing for breaking, shearing, tearing, and bursting strengths is considered. Various abrasion testers are referred to, and spinning tests, measurements on staple, shrinkage, and crêping measurements, swelling, and testing the warmth of fabrics are reviewed. The German standards organizations are described.

54. Guatemala: Cotton Textile Industry. (*The Ambassador*, March, 1947, p. 154.) The cotton textile industry consists of four mills, the largest of which accounts for about 60 per cent. of power-loom output in the country; three of these mills are in Guatemala City, and the other in the department of Quezaltenango.

In addition, there is a large hand-weaving industry both in the capital and in outlying provinces. In 1945 the output of woven cotton fabrics totalled some 3,430,000 lb.; about 90 per cent. of this was woven from domestic yarn and 10 per cent. from imported yarn. Annual yardage output of the three leading mills is given as 6,621,000 yards or about 65 per cent. of the country's total output of cotton fabrics. Imports of cotton fabrics into Guatemala are estimated at 2,300,000 lb. per annum; these supply about 40 per cent. of domestic demand. A minor but important textile industry of the country is the manufacture of speciality cotton fabrics woven by Indians; this continued at a relatively high level in 1946, with sales to tourists augmented by shipments to overseas markets. Raw cotton for domestic mills is supplied partly by home production and partly by imports. Guatemalan production of ginned cotton for the crop year 1946-47 is estimated at some 1,600,000 lb.; 1944-45 production was just under 2,000,000 lb., as seed was better and labour more plentiful. Cotton consumption in Guatemala in the year ended July 31, 1946, was 4,160,000 lb., consisting of the domestic crop plus imports at 2,240,000 lb. Imports are chiefly from Ecuador (about 50 per cent.) and Peru (about 40 per cent.); in 1945 total imports were 2,182,066 lb., valued at $414,715.

55. Java Cotton: Spinning Tests. By W. Spoon. (*Ber. Afdeeling Handels-museum Kol. Inst.*, 175, 1941. From *Summ. Curr. Lit.*, xxvii, **18**, 1947, p. 361.) The author reviews briefly the history of cotton growing in the Dutch Colonies, and summarizes the opinions of various scientists on future developments. Results of spinning tests, independently carried out by three spinners, on the Cambodia and Peradeniya varieties of Java-grown cotton, are appended; they have been found comparable to American cotton of strict middling quality.

56. Philippine Textiles. (*The Ambassador*, July, 1947, p. 161.) Cotton textile mill operations in the Islands during 1946 began to recover the ground lost under the Japanese occupation. A mill which before the war had 504 looms and 20,000 spindles, by September, 1946, was operating 175 looms, 14,000 spindles and 20 spinning frames. The spindles were producing 7,500 lb. daily, two-thirds of which went to the production of cloth at the rate of 10,000 yards per day; the remainder of the yarn was sold to home weavers in the Ilocos Provinces, and to manufacturers of fish nets. When the necessary spare parts are forthcoming the remaining 6,000 spindles will come into operation. 17,000 Japanese spindles have also been allocated to the mill. Plans are in progress to establish two more cotton textile mills, one in Manila, and the other in Cebu; the planned capacity of these is some 700 looms and 25,000 spindles.

57. Turkey: Cotton Cultivation. By N. Tourgay. (*Coton et Fib. Trop.*, 1, 1946, p. 67. From *Summ. Curr. Lit.*, xxvii, **10**, 1947, p. 207.) The history of the Turkish cotton industry is briefly reviewed and the main cotton growing regions and their climatic conditions are discussed. The chief cotton varieties and their properties are described. Crop rotations, manuring, tilling, sowing, upkeep and irrigation practices, cotton insects and diseases, harvests and yields, ginning, pressing and baling, cotton sales and markets, the cotton manufacturing industry, and the organization and legislation of cotton cultivation are considered. A number of statistical data are presented.

58. Uruguay: Textile Industries. (*The Ambassador*, September, 1947, p. 150.) Activity in the textile industries of Uruguay is increasing with a rise in the imports of yarns, a shortage of which has restricted production during the past few years. Towards the end of 1946 there was a substantial increase in imports of cotton yarns, from 76,631 to 232,810 kg. between the second and third quarter, for example; this was the result of large supplies from the U.S.A., with some quantities from Belgium and Italy. Brazil, latterly the chief source of cotton yarns, declined in importance. With domestic production at the level of some 750,000 kgs., total yarn consumption by Uruguayan cotton mills reached a level of 930,000 kgs. by the end of the year. Imports of cotton fabrics have, as a result, been declining.

STATISTICAL TREATMENT, CULTIVATION, GINNING, ETC.

59. MECHANIZATION OF COTTON PRODUCTION. (World Fibre Survey of the F.A.O. From *Cott. and Genl. Econ. Rev.*, 17/10/47.) Over the long range period, world cotton production prospects, shifts in producing areas and changes in the structure and organization of cotton growing may be decisively influenced by the scale and speed of the transition to mechanized agriculture in the United States and in some other countries. . . . While tractor farming had been extended into the cotton belt of the United States prior to World War II, specialized machinery to perform all the operations of cotton cultivation had not been introduced on a significant scale. By 1947 there was reason to believe that most of the residual technical difficulties which stood in the way of full mechanization could be solved. In the United States it has been found that three families can cultivate eighty hectares of cotton under conditions of full mechanization, whereas about twenty are required to chop, hoe and hand-pick an equivalent area. This estimate does not take account, however, of peak labour requirements under unfavourable weather. . . . Another problem of machine picking arises from the loss in grades. However, continued development of ginning techniques and defoliation of the plants should reduce grade losses. Mechanization of cotton culture will prove very difficult on small farms. The heavy capital requirement would tend to exclude the average farmer from cotton cultivation, unless easy credit is assured, and would encourage a progressive consolidation of acreage, together with a change-over of small farm units to crops other than cotton. The social problems arising from large-scale mechanization are generally conceded to be most serious. With the development of the cotton pickers, mechanization is likely to be introduced rapidly and in an integrated fashion, as machinery is now available to cope with virtually all major agricultural operations. Accordingly, mechanization of cotton agriculture should stimulate a similar process in corn, hay and other crops, and thus magnify the impact on agricultural employment. Since the cost advantages of mechanization in many of the United States cotton areas appear indisputable, large-scale introduction of new machinery can be anticipated. Other cotton-producing countries are not likely to mechanize production at the same rate as appears probable in the United States.

In Brazil, capital resources and the technological level of cotton cultivation are not equal to those of the United States. Besides the rolling character of the southern Brazil cotton land, the large amount of newly cleared areas make it difficult to introduce fully mechanized methods. At the same time, Brazilian growers may eventually be compelled to shift to a more intensive type of cotton culture, utilizing the application of fertilizers, erosion control and crop rotation, instead of periodically replacing worn-out land by virgin areas. . . . Large areas in Argentina are topographically well adapted to the introduction of mechanized cotton growing. As labour shortage has been the principal obstacle to an extension of cotton production, mechanization might be adopted at a fairly rapid rate. . . . In Egypt, India and China, no rapid progress in mechanization can be anticipated in view of the low rates of pay, the abundance of rural labour, and the revolutionary changes which would be required in the structure and organization of the agricultural economies of those countries. . . . In India, the Government has adopted a five-year plan for cotton production, but how far the partition of India will affect these plans is uncertain. . . . The long-range future of cotton production in China, on the assumption that the nation will eventually be unified and inflation brought under control, appears moderately promising. Although methods of cultivation are crude, it is noteworthy that Chinese yields are only slightly less than the United States average. . . . In the U.S.S.R. rapid mechanization might be feasible, but resources probably cannot be spared for introducing the most modern implements of mechanized cotton culture within the current five-year plan. . . . The spectacular increases in cotton yields projected in the plan are remarkable in view

of the severe war-time losses of fertilizer and draft power. . . . Accomplishment of the goal of the five-year plan would make approximately 5 kilograms of cotton per caput available to the estimated U.S.S.R. population of 198,000,000 in 1950; this output could readily be consumed within the U.S.S.R. frontiers.

COTTONSEED AND COTTONSEED OIL

60. Summary of Co-operative Tests of Cotton Seed Treatments, 1946. By C. H. Arndt *et al.* (*Pl. Dis. Rptr.*, xxxi, **5**, 1947. Mimeographed. From *Rev. App. Mycol.*, xxvi, **10**, 1947, p. 450.) In 1946 cottonseed treatments were compared in two tests in fourteen plantings in nine of the United States. In the first, Du Pont 1452F (ethyl mercury *p*-toluene sulphoanilide) and Dow-9B (zinc 2-4-5 trichlorophenate) were compared at a rate of 3 gm. per kg. (1·5 oz. per bush.) on fuzzy, fuzzy-matted, lightly reginned, lightly reginned-matted, heavily reginned and acid-delinted seed. In the second, seven treatments were compared on Stoneville 2B cotton seed well infested by the anthracnose fungus (*Glomerella gossypii*). In both tests Dow-9B and Du Pont 1452F were about equally effective, when the number of seedlings surviving until the final seedling count was used as a criterion of effectiveness. The highest percentage seedling stands were obtained with the delinted treated seed. Some seed treated with dusts containing 20, 30 and 50 per cent. zinc trichlorophenate were compared in several plantings in North and South Carolina. The 50 per cent. dust tended to be slightly superior, while the 20 per cent. dust was greatly inferior in one planting. The effectiveness of Du Pont 1452F and Dow-9B was not improved by the addition of fermate or zerlate. Preliminary tests indicated that neither of these dusts at dosages of 10 gm. per kg. would destroy *G. gossypii* in the seed.

61. Research at the Southern Regional Research Laboratory, Pennsylvania. By H. T. Herrick. (*Sci. in Frmg.*, U.S. Yrbk. of Agr., 1943-47, p. 691.) For many years gossypol was the only pigment known to be associated with cottonseed. Research at the Laboratory led to the detection of several other pigments, three of which have been isolated and identified: Gossypurpurin (purple in colour), gossyfulvin (orange in colour), both from raw cottonseed, and gossycaerulin (blue in colour), from cooked cottonseed. Microscopic investigation of the distribution of the predominant pigments in cottonseed tissue has shown them to be concentrated in pigmented glands. The glands are mechanically strong, resist the action of many organic liquids, and have a density less than that of other cottonseed tissue. With this knowledge, a process was devised for the mechanical removal of pigments from cottonseed; it consists in floating the largely intact glands on the surface of a mixture of organic liquids that has a density intermediate between that of the glands and that of the other seed tissue. A fractionation unit of prepilot plant scale has been constructed and operated to separate pigment glands from solvent extracted cottonseed flakes. The liquid for the fractionation process is a mixture of tetrachlorethylene and Skellysolve B, adjusted to a specific gravity of 1·378 at 27° C. . . . A sufficient quantity of cottonseed pigments is available for a determination of the physical, chemical and toxicological properties of these colouring matters, and a study of their functions in relation to seed maturity, seed storage, processing conditions and industrial utilization, and toxicological and nutritional factors.

62. Storage of Cottonseed and Peanuts under Conditions which Minimize Changes in Chemical Composition. By M. F. Stansbury and J. D. Guthrie. (*J. Agr. Res.*, **75**, 2, 1947, p. 49.) Cottonseed samples may be stored for more than a year without appreciable change in total nitrogen, total oil, free fatty acid content, iodine, or peroxide number of the oil, or catalase activity of the kernels, by drying to a moisture content of 8·3 per cent. or lower, placing in sealed containers, and storing at 1° C. or below. Under this type of storage at room temperature a small increase in the free fatty acid content of the oil occurs. Unshelled peanuts may be

stored for more than two years in closed cans at 1° C. or below without appreciable change in the total nitrogen or oil content of the kernels, or in free fatty acid content or iodine number of the oil.

63. COTTONSEED AND COTTON FIBRE: UPTAKE OF HYDROCHLORIC ACID DURING "FUMING." By A. R. Faust and F. A. Henson. (*Oil and Soap*, **23**, 1946, p. 74. From *Summ. Curr. Lit.*, xxvii, **10**, 1947, p. 221.) Various samples of cottonseed and separated cottonseed hulls, meats, lint, raw cotton fibre and purified cotton fibre were fumed in hydrochloric acid according to the official method for the determination of residual lint; after heating for two hours at 101° C. the hydrochloric acid absorbed and retained by the samples was determined gravimetrically as silver chloride. All parts of the seed are capable of absorbing hydrochloric acid. This would have the effect of introducing an error of −0·3 to −0·4 per cent. in the lint determination. In the case of raw cotton fibre, non-cellulosic constituents appear to be largely responsible for the uptake of hydrochloric acid, since purified fibres retain very little HCl; neither the ash nor any waxy constituent appears to be responsible as a major factor.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL

64. INSECT PESTS OF COTTON IN EGYPT. By I. Bishara. (*Egypt Cott. Gazette*, 1947, pp. 47, 71.) The pests dealt with in these two papers include the spiny bollworm, pink bollworm, cotton worm, cutworm, aphis, thrips, capsid bug, green shield bug and cottonseed bug. The life history of the major cotton pests—the bollworms—is discussed and various measures of control are suggested.

65. A CONTRIBUTION TO THE KNOWLEDGE OF INSECTS HARMFUL TO COTTON IN ITALIAN EAST AFRICA. I. LEPIDOPTERA. By G. Russo. (In Italian. *Boll. R. Lab. Ent. Agr. Portici*, **3**, 1940, p. 105. From *Rev. App. Ent.*, xxxv, Ser. A. **7**, 1947, p. 226.) The author studied the pests of cotton in Somalia in 1930, and this paper gives the results of his observations on Lepidoptera. The species dealt with comprise *Platyedra gossypiella*, Saund., *Pyroderces coriacella*, Sn., and *Argyroploce leucotreta*, Meyr., which chiefly attack the bolls; *Earias biplaga*, Wlk., *E. insulana*, Boisd., *Diparopsis castanea*, Hmps., and *Heliothis armigera*, Hb., which damage bolls, flowers, and shoots; *Acrocercops bifasciata*, Wesm., *Sylepta derogata*, F., *Diacrisia (Spilosoma) investigatorum*, Karsch, *Prodenia litura*, F., and *Cosmophila flava*, F., which feed on the leaves; *Mometa zemiodes*, Durrant, which attacks the seeds in the field and continues to infest them in store; *Corcyra cephalonica*, Staint., which is a pest of the stored seed only; and *Euproctis fasciata*, Wlk., which was taken in rearing cages containing branches and leaves of cotton, and had not previously been recorded from Somalia. Descriptions are given of their various stages, together with accounts (for all except the last) of their world distribution, bionomics and alternative food-plants, and suggestions for their control.

The pest dealt with in greatest detail is *Platyedra gossypiella*, all stages of which were present throughout the year, and which destroys 20-30 per cent. of the crops in Somalia. The female lays about 250 eggs, which hatch in 3-4 days. The larvæ complete their development in 15-20 days, and pupate below the surface of the ground or occasionally in fallen bolls. The adults emerged after 9-12 days, and survived in captivity for 10-12 days. The larvæ were parasitized by *Brachymeria inornata*, Masi., *Eurytoma verbena*, Ferrière, *Microbracon kirkpatricki*, Wlkn., which was the most important, and a species of *Chelonus* identified by Ferrière as *C. versatilis*, Wlkn. It is stated in a footnote that Masi could find no difference of specific importance between examples of this species from Somalia and those previously identified by Wilkinson as *C. curvimaculatus*, Cam. The mite, *Pediculoides ventricosus*, Newp., and the ant, *Tetramorium sericeiventre*, Emery, were predaceous on the larvæ of *Platyedra*, while an Anthocorid of the genus *Orius (Triphleps)* attacked the eggs. Control measures are discussed from the literature; those considered most applicable in Somalia include the prompt collection of infested bolls and the exposure to direct sunlight of the raw cotton, spread out in a

layer so that the larvæ are either killed by the heat (exposure for 5-10 minutes to 50-60° C. [122-140° F.] is sufficient) or destroyed as they leave the cotton to seek shelter. . . . Larvæ of *Earias biplaga* and *E. insulana* were occasionally parasitized by an unidentified Braconid of the genus *Rogas*, and those of *Heliothis armigera* by *Apanteles* sp., and two Tachinids. Adults of *Antrocephalus æthiopicus*, Masi, and *A. crassipes*, Masi, were taken in a store containing cottonseed, and these Chalcids may, therefore, have been parasitic on *Corcyra cephalonica*.

66. Cotton Insect Pests in the Ivory Coast. By R. Delattre. (*Coton et Fibres Trop.*, **2**, 1947, p. 28. From *Summ. Curr. Lit.* xxvii, **19**, 1947, p. 394.) The major pests considered are: *Helopeltis bergrothi*, *Lygus simonyi*, *Bemisia tabaci*, and *Platyedra gossypiella*.

67. Sulphur as an Aphicide. By D. Isely and F. D. Miner. (*J. Econ. Ent.*, **39**, 1, 1946, p. 93. From *Rev. App. Ent.*, xxxv, Ser. A, **6**, 1947, p. 181.) Inconsistent results have been obtained when sulphur, to control *Aphis gossypii*, Glov., on cotton, has been added to insecticides applied in dusts against other insects, but in various experiments carried out in Arkansas in 1942, 1944 and 1945, sulphur and dust mixtures containing it applied to the undersides of cotton foliage one to four times at 15-30 lb. per acre, depending on the size of the plants, reduced the average aphid population to 5·81 per cent. of that on untreated plots. When three or four applications were made in plot tests, the average infestation was less than 1 per cent. of that on untreated plots, and when only one application was made in a field test it was 48 per cent.

68. Benzene Hexachloride to Control Bugs on Cotton. By W. A. Stevenson and L. W. Sheets. (*J. Econ. Ent.*, **39**, 1, 1946, p. 81. From *Rev. App. Ent.*, xxxv, Ser. A, **6**, 1947, p. 180.) Since dusts of arsenicals in sulphur have given variable control of the Hemiptera (chiefly Pentatomids and Mirids) that injure cotton in Arizona, and D.D.T. and sabadilla mixtures, although promising, have not been completely satisfactory, preliminary tests were made with benzene hexachloride. The dusts used in the cage tests were benzene hexachloride ground with talc or deodorized benzene hexachloride ground with gypsum. They contained 10 and 2 per cent. respectively of the active γ-isomer, and were further diluted with pyrophyllite for tests. When the insects were caged with cotton plants, which were then dusted, dusts containing 1, 2 and 10 per cent. γ-isomer caused 75, 85 and 100 per cent. mortality of *Euschistus impictiventris*, Stal, 8-29 and 19-43 hours after treatment, and one containing 5 per cent. gave complete mortality of *Creontiades femoralis*, Van D., and of species of *Lygus* 15 and 3 hours after treatment respectively. In another series, in which the 5 per cent. dust was applied to caged cotton plants at varying periods before the introduction of the insects to test the residual effect, a dust applied 90 hours before killed 90 per cent. of *Lygus* spp. and 20 per cent. of *C. sayi* in 46 hours, a dust applied 24 hours before killed 100 per cent. of *Lygus* in 4 hours, and 60 per cent. of *C. sayi* in 46 hours, and a dust applied immediately before killed 80 per cent. of *C. sayi* and 60 per cent. of *E. impictiventris* in 46 hours. Comparison with previous tests showed that the mortalities were considerably higher than those usually given by arsenicals in sulphur, and rather higher than those given by D.D.T. or sabadilla, and in all tests benzene hexachloride killed the insects more quickly than the sulphur and arsenicals or D.D.T. In a field test, unground benzene hexachloride diluted with pyrophyllite to contain 1 per cent. γ-isomer was applied soon after daylight on July 20 and 27 and August 3 and 17, at approximately 20 lb. per acre per application, to cotton plants that had a mixed population of injurious Hemiptera of 15 per 100 strokes of the net. Weekly population counts, continued until September 5, showed an average of 4·1 injurious Hemiptera per 100 strokes after dusting was begun, as compared with 7·3 in the untreated plot. The final yields were 2,297 lb. seed cotton per acre for the treated plot, and 1,547 for the untreated one. Benzene hexachloride caused no injury to cotton in any of the tests.

[*Cf.* Abstr. 457, Vol. XXIII of this Review.]

69. COTTON JASSID IN THE PUNJAB. By M. Afzal and M. A. Ghani. (*Ind. Frmg.*, vii, 9, 1946, p. 407.) A review of the research work on jassid carried out at Lyallpur during the past eight years. Light-trap collection of jassids, the different species of jassid encountered in the Punjab, and alternative host plants, are considered. The results of extensive studies of the jassid population are reported. It is stated that the causes of resistance or susceptibility of the plant must be sought in the leaf-vein, as it is here that the eggs are laid and infection starts. Of all the characters of the leaf-vein studied hairiness was the most important, being normally linked with jassid resistance.

70. LOCUST CONFERENCE IN NORTHERN RHODESIA. (*Crown Col.*, August, 1947, p. 441.) At the International Red Locust Organization Conference held in Lusaka, Northern Rhodesia, in June, 1947, Dr. Uvarov, who is a world authority on locusts, outlined the African situation as regards the present activities of the Red Locust. A major invasion over a large part of Africa would probably have already developed had it not been for the energetic campaigns during the last two years, which had been waged by the International Red Locust Control Service, based in Abercorn. Financial limitations had made these campaigns inadequate to eliminate all danger, because the outbreak was on a larger scale than anticipated. Swarms which had escaped in 1945 had been reinforced by further escaping swarms in 1947, and some breeding had already occurred in the west of Tanganyika in an area adjacent to land scheduled for the groundnut scheme. Swarms were now threatening Tanganyika, Uganda and the Belgian Congo. Unless their breeding in the coming season were effectively controlled, they would constitute the greatest danger to food production and development schemes for the next fifteen years, including the vast groundnut project. A vigorous campaign in the coming season was the last chance of saving the situation. This campaign should be financed from a common pool controlled by a small executive body of the International Council to co-ordinate measures in all territories. Governments should give these measures the highest priority. Dr. Uvarov stressed the need for an organized intelligence system and for the immediate reporting of all locust swarms and hoppers. He referred to aircraft control methods, which held promise.

71. THE USE OF GAMMEXANE IN LOCUST CONTROL. (*Food and Agr.*, 1, 1947, p. 51.) Gammexane is used in the anti-locust campaign for poisonous baits. It is mixed preferably with bran, and is equally, if not more, efficient than sodium arsenite, which is generally used. But while the use of the latter may be dangerous, gammexane has the great advantage of being harmless to men, domestic animals and plants, while its action on locusts of all ages, when spread as a powder or used as a spray, is very effective. During the tests made, the insects brought into contact with baits poisoned with gammexane died even before eating them, which leads to the belief that this substance acts on the nervous system of the insects. It is important to know that gammexane should not be kept in sacks, but in metal drums: only when thus stored does it preserve its efficiency; if stored otherwise the volatile ingredients evaporate.

72. ANTI-LOCUST PLANES. (*Crown Col.*, September, 1947, p. 498.) The Government of South Africa is lending four Ansons equipped for anti-locust spraying, which is to be carried out in the Rukwa area, together with one Dakota for transport work, and the necessary technical staff. Funds under the Colonial Development and Welfare vote have been allocated to provide two more Ansons for this work.

73. EVOLUTIONARY SIGNIFICANCE OF PERIODICITY OF VARIATION-INTENSITY AND POPULATION-FLUX IN THE DESERT LOCUST. By M. L. Roonwal. (*Nature*, 28/6/47, p. 872.) The periodic mass-increase in the population of the desert locust, *Schistocerca gregaria*, Forsk., which ranges from Africa to India, is a phenomenon known since Biblical times. The compilation of historical records over the past 150 years has established an *average* 11-year cycle of mass-increase, although the individual periods are far less regular. Following Uvarov's work, the existence of two phases, namely the swarming or *gregaria* phase and the non-swarming or *solitaria* phase,

has also been established. As the result of considerable investigation in various countries, the following important conclusions emerge: (i) The population fluctuates periodically, the "plague period" of high numbers corresponding with a considerable increase of range of the species. (ii) As regards variation intensity, the species is comparatively stable during the plague or *gregaria* period but highly polymorphic during the *solitaria* period when the population is low. (iii) The phenomenon is periodic and evidently occurs over a wide range (India to Africa) more or less simultaneously. (iv) It would appear that the 7- and 8-eye-striped individuals, which make their appearance during *solitaria* periods when selection-pressure is low, probably owing to reduced numbers, are eliminated, presumably by selection, during the *gregaria* periods of high population and increased selection-pressure. Crossing results show that 6-striped individuals produce both 6- and 7-striped forms in F_1 and F_2 generations.

[*Cf.* Abstr. 450, Vol. XXII of this Review.]

74. ON A NEW PHASE CHARACTER: THE METASTERNAL INTERSPACE, IN THE DESERT LOCUST, *Schistocerca gregaria*, FORSK. By M. L. Roonwal. (*Proc. R. Ent. Soc. Lond.*, (A) 21, **1-3**, pp. 13-15, 1946. From *Rev. App. Ent.*, xxxv, Ser. A, **6**, 1947, p. 198.) Examination of a series of specimens of *Schistocerca gregaria*, Forsk., in India showed that adults, particularly males, of the phases *gregaria* and *solitaria* could be distinguished from each other by the size and shape of the metasternal interspace. In phase *solitaria*, the "metasternal index" obtained by dividing the maximum width at the anterior end of the interspace by the minimum width was about 2·8 in males and 1·5 in females, whereas in phase *gregaria* it was about 1·2 in both sexes.

75. CONTRIBUTION TO THE MORPHO-BIOLOGICAL AND SYSTEMATIC STUDY OF ERITREAN ORTHOPTERA. II. ABNORMALITIES IN THE MATERNAL INSTINCT IN *Schistocerca gregaria*, FORSK., ph. *gregaria* OBSERVED IN ERITREA IN 1944. By G. Jannone. (In Italian, with English summary. *Bol. Soc. Ital. Med.* [Sez. Eritrea], **5**, 1-3, 1945, p. 41. From *Rev. App. Ent.*, xxxv, Ser. A, **10**, 1947, p. 307.) The author describes two cases of abnormal oviposition by *Schistocerca gregaria*, Forsk., ph. *gregaria*, observed in Eritrea in 1944. In the first, some females, instead of depositing egg-pods in soft, loose soil, abandoned their eggs in small rectangular heaps on the pebbles beside the Alighedé river. This was attributed to their having been disturbed by men or cattle passing when they were about to oviposit in the sandy soil of the watercourse. In the second case, egg-pods were deposited in clay or limonitic soils, in isolated places on the Eritrean highlands, where swarms would be unable to develop.

76. SOME EAST AFRICAN SPECIES OF *Lygus*, WITH NOTES ON THEIR HOST PLANTS. By T. H. C. Taylor. (*Bull. Ent. Res.*, **38**, 2, 1947, p. 233.) A study of the genus, as it occurs in East Africa, with a view to reliable determination of species, of which some 20 are concerned. Only a few of them occur commonly on cotton, and only one, which must now be called *L. vosseleri*, Popp., is a major pest of cotton, but the others were encountered, in most cases very frequently, in connection with an investigation of the alternative host plants of the cotton-frequenting species, and two are common on coffee (with *L. coffeæ*, China, which belongs to a different group of species and is therefore not included here). Some of them bear a very close resemblance to *L. vosseleri*, and often occur with it on the same plants and in the same localities; consequently, considerable confusion had existed previously as to the identity of the various species collected.

77. ON THE IDENTITY OF THE COTTON CAPSID OF UGANDA. By T. H. C. Taylor. (*Bull. Ent. Res.*, **37**, 1947, p. 503. From *Rev. App. Ent.*, xxxv, Ser. A, **7**, 1947, p. 213.) A Mirid that is injurious to cotton in Uganda was known as *Lygus vosseleri*, Popp., prior to 1935, and subsequently as *Lygus simonyi*, Reut., owing to the adoption of the view that *L. vosseleri* is a synonym of *L. simonyi*. From a comparison of specimens with cotypes of both sexes, of *L. simonyi*, a cotype female of *L. vosseleri* and both sexes, including the female type, of *L. schonlandi*,

Dist., the author finds, however, that *L. schonlandi* is a synonym of *L. simonyi*, that *L. vosseleri* is not, and that the cotton Mirid of Uganda is *L. vosseleri*, and not *L. simonyi*. *L. simonyi* is common in Uganda on plants other than cotton, but is only a rare visitor on the latter. Poppius, in his list of localities for *L. vosseleri*, included Amani (Tanganyika) and stated that it is injurious there to castor (*Ricinus*). The cotton Mirid is rare in Uganda on *Ricinus*, which is attacked severely by a closely related species. Poppius's description of *L. vosseleri* applied to the cotton Mirid, and not in all respects to this related species.

[*Cf.* Abs. 548, Vol. XXII of this Review.]

78. THE STATUS OF HEAT TREATMENT OF PLANT COTTON SEED FOR THE CONTROL OF PINK BOLLWORM, *Pectinophora scutigera*, HOLD., IN QUEENSLAND. By W. J. S. Sloan. (*Qd. J. Agr. Sci.*, **3**, 1, 1946, p. 70. From *Rev. App. Ent.*, xxxv, Ser. A, **9**, 1947, p. 273.) The author describes an investigation carried out at a ginnery in 1941 to ascertain whether the heat treatment applied in Queensland to cotton seed intended for planting to free it from infestation by *Platyedra* (*Pectinophora*) *scutigera*, Hold., is necessary. Samples were collected from the seed stream after cleaning but before heating, and from the bags in which the seed was stored. Over 98,000 seeds were examined individually, of which 28·3 per cent. were classed as defective through various causes, but no double seeds, which are characteristic of resting larvæ of *P.* (*P.*) *gossypiella*, Saund., and only two dead larvæ of *P. scutigera* were found. One sample of stored seed was infested with *Ephestia cautella*, Wlk., and *Tribolium castaneum*, Hbst., but it had been kept near oil-mill seed, which is usually infested by these insects. It was concluded that infestation by *P. scutigera* is not heavy in plant seed from high-grade seed cotton; that any larvæ present are almost all removed during the various cleaning processes; and that heat treatment of the cleaned seed is therefore superfluous. The absence of larvæ in the seed indicates that *P. scutigera*, unlike *P. gossypiella*, Saund., does not form a larval resting stage within the seed, though it does have a prolonged larval stage in winter, since larvæ collected in late autumn and early winter, and kept with dry undelinted seed and debris, did not pupate for periods as long as sixteen weeks. The investigation emphasizes the importance of field sources of infestation, of which the chief are ratoon or standover cotton, undestroyed crop residues, and wild Malvaceous plants, while sheds and railway trucks used in the storage and transport of cotton may be minor sources.

79. CO-OPERATION BETWEEN THE UNITED STATES OF AMERICA AND THE REPUBLIC OF MEXICO FOR THE CONTROL OF THE PINK COTTON BOLLWORM. By A. Delgado de Garay. (In Spanish. *J. Econ. Ent.*, **39**, 1, 1946, p. 95. From *Rev. App. Ent.*, xxxv, Ser. A, **6**, 1947, p. 182.) Since about 1920, officials from the United States have co-operated with the Mexican authorities in efforts to control the pink bollworm on cotton in Mexico. Co-operation was placed on an organized basis by government agreement in 1943, when permanent staffs were appointed by the authorities of both countries to supervise the work in each of the seven regions into which the cotton-growing areas of Mexico were divided. The measures adopted include the sterilization of cottonseed, the burning of ginning waste and old stalks, field sanitation, and the prevention of ratoon cultivation. As a result of the work the bollworm has been eradicated from a considerable area in the State of Nuevo Leon and a rather smaller one in Coahuila.

80. THE ANATOMY OF THE HEAD AND MOUTH PARTS OF *Dysdercus intermedius*, DIST. By Elsie I. MacGill. (*Proc. Zool. Soc.*, vol. cxvii, pt. 1, 1947.) *Summary.*—Miss H. Frazer has given a brief general account of the mouth-parts of *Dysdercus intermedius* in her paper on the transmission of internal boll disease of cotton. In the present paper, this description is amplified and augmented. The arrangement of the sclerites forming the head capsule of *D. intermedius* is described. The maxillary plates have internal projections, the maxillary processes, which support the stylets in the anterior part of the head. The sucking pump, described as the pharynx by many authorities, is an external chamber and not a true pharynx.

It is formed by the flexible dorsal epipharynx, to which are attached the dilator muscles, and the rigid, ventral hypopharynx. The anterior end of the hypopharynx is drawn out into the pharyngeal duct, which is inserted into the suction canal between the stylets. The two pairs of stylets are enclosed in a chamber, the stylet pouch, formed inside the head by the invagination of the outer wall of the head capsule and by the wing of the hypopharynx. The mandible is the outer of the two stylets. The protractor muscle of the mandible is attached to the mandibular lever and not directly to the stylet; the retractor muscle is directly attached to the base of the mandible. The maxillary stylet represents the lacinia of the maxilla of other insects, the rest of the appendage forms the maxillary plate. Both the pro- and retractor muscles of the maxilla are attached to the base of the stylet. There are no maxillo-mandibular muscles. The saliva is forced down the salivary canal between the stylets by a highly developed salivary syringe. Two salivary ducts, their openings guarded by simple valves, open into the pump chamber. There is no valve at the exit of the common ejaculatory duct which runs through the body of the hypopharynx and opens into the salivary canal between the stylets. The epipharynx is pierced by two series of pores leading to sensory cells lying dorsal to the epipharynx. From their position these cells are supposed to be a gustatory organ. *Dysdercus intermedius* has paired maxillary glands lying inside the maxillary plates and opening by numerous small pores on their anterior faces. It is suggested that the secretion from these glands may be to lubricate the stylets or to help to bind the stylet bundle together, and so strengthen it. The salivary glands are of the four-lobed type with duct-like accessory glands.

[*Cf.* Abstr. 176, Vol. XXII of this Review.]

81. Investigaciones sobre el Genero *Dysdercus* Serville (Hemipt. Pyrroc.). By M. A. Freiberg. (*Algodon*, Nos. 125-126, 1945, p. 362.) I. A description of *Dysdercus pallidus*, Blöte, which attacks cotton in Argentina, and is distinct from the varieties *D. ruficollis* and *D. mendoza*, studied in Peru and Brazil respectively. The life cycle, copulation, oviposition, incubation, stages of development, and colour variations are described. Variations in size dependent on nutrition are discussed. II. The biology of another species of *Dysdercus*, found in North-East Formosa, Argentina, and in Paraguay is also described. The article is well furnished with drawings of the insects in question.

82. Termites (White Ants) and Their Control. By H. B. Wilson. (*J. Dpt. Agr. Vict.*, **44**, 6, 1946, p. 261. From *Rev. App. Ent.*, xxxv, Ser. A, **10**, 1947, p. 314.) Measures recommended for control in buildings not protected against termites comprise treating the soil and posts that enter it with creosote or blowing white arsenic powder into the termite galleries in the timber, though this does not necessarily prevent re-infestation.

83. Finished Cotton Fabrics: Attack by Termites and Micro-organisms. By N. H. Shah. (*Ind. Text. J.*, **57**, 1946, p. 241. From *Summ. Curr. Lit.*, xxvii, **9**, 1947, p. 189.) The effectiveness against attack by termites and micro-organisms of sixteen finishing treatments applied to cotton fabrics has been determined. In general, treatments that protected fabric from attack by termites also made it resistant to micro-organisms. However, some mildew-resistant treatments allowed slight attack by termites, and two allowed heavy attack. The following treatments gave excellent protection against attack by both agencies: cuprammonium hydroxide, copper oleate, a mixture of copper naphthenate and copper oleate, mercuric chloride with 8-hydroxyquinoline, and copper naphthenate. The following treatments permitted light attack by termites, and with the exception of cuprammonium fluoride gave excellent protection against micro-organisms: cuprammonium fluoride, copper sulphate with 8-hydroxyquinoline, and two different proportions of each of two natural dye extracts, osageorange and quercitron, with copper sulphate and potassium dichromate. The other treatments tested were ineffective in preventing termite damage.

84. Combating Cotton Diseases in Szechuan. By L. Ling *et al.* (*Rpt. Szechuan*

Agr. Improvement Inst., 1942. In Chinese. From *Rev. App. Mycol.*, xxvi, 7, 1947, p. 300.) From 1939 to 1941 the control of cotton diseases in northern Szechuan was carried out by spraying with Bordeaux mixture twice during the growing season, in July and August. The results obtained from eighty-one demonstration plots during the three-year period showed that the spraying effected an average increase in yield of 14·8 kg. seed cotton per shih mow (1 shih mow = $\frac{1}{6}$ acre) over the check, at a cost of about one-fifth of the gain.

85. Descriptions of Chalcidoids collected in Somalia by Prof. G. Russo, with Notes on Congeneric Species. By I. Masi. (In Italian. *Boll. R. Lab. Ent. Agr. Portici*, 3, 1940, p. 247. From *Rev. App. Ent.*, xxxv, Ser. A, 7, 1947, p. 227.) In the course of the introduction to this paper the author states that a comparative examination has shown no specific characters differentiating *Dirhinus auratus*, Ashm., or *D. frequens*, Masi, from *D. excavatus*, Dalm. In the main part of the paper he describes, from material collected in 1930 by Russo in Somalia, the adults of twenty-two species and one variety of Chalcidoids in twelve genera; eighteen species (for one of which a new genus is erected) and the variety are new. The new species include the Chalcids, *Brachymeria inornata*, reared from fruits of *Hibiscus dongolensis* infested by larvæ of *Platyedra gossypiella*, Saund., and *Antrocephalus crassipes*, adults of which were taken in a cotton-seed store, and the Eulophid, *Dimmockia somalica*, which is thought to be a parasite of *Acrocercops bifasciata*, Wlsm., on cotton. (*Cf.* Abstract 65.)

86. Effect of Hydrogen-ion Concentration on the Growth and Parasitism of *Sclerotium rolfsii*, Sacc. By S. Chowdhury. (*Ind. J. Agr. Sci.*, xvi, 3, 1946, p. 293.) In experiments carried out to determine the effect of hydrogen-ion concentrations on the growth and parasitism of *S. rolfsii*, it was found that the fungus can grow over a wide range of *p*H and the optimum for growth and sclerotial formation lies at 6·4. The hydrogen-ion concentration of a large number of soils obtained from healthy and affected fields was determined; no appreciable difference in the *p*H values of these soils could be noticed. The effect of changing soil reaction in an infected plot on the incidence of the disease was studied, and it was found that no correlation existed between the hydrogen-ion concentration of the soil and the incidence of the disease.

87. Notes on the Tachinid Parasites of Cotton Stainers (*Dysdercus* spp. Pyrrhocoridæ) in South Africa. By R. C. Rainey. (*Bull. Ent. Res.*, 38, 2, 1947, p. 305.) Up to 35 per cent. of adult *Dysdercus nigrofasciatus* from a heavily infested late cotton crop at Barberton were found to be parasitized by Tachinid larvæ at the end of the season. The predominant Tachinid species was *Alophora nasalis*; *Bogosiella fasciata* was present in smaller numbers, and appears to be more common in regions of higher rainfall. The development of the Tachinid larva within the stainer was a protracted process under local winter conditions, the larval period of *A. nasalis* being of the order of 2-3 months, and parasitized stainers were correspondingly long-lived. The possible economic significance of the parasites is discussed.

The present observations, while indicating higher levels of parasitism than had previously been recorded either locally or in Uganda, have also demonstrated the surprising longevity of parasitized stainers. Furthermore, the heavy stainer attack of 1931 afforded no indication of effective parasite activity. So far there is, in fact, no local evidence of any serious effects on stainer numbers attributable to the Tachinids, whose economic value appears correspondingly slight, though further observations, particularly of parasite activity on wild host-plants, might still be of considerable interest.

88. Cotton Anthracnose: Occurrence. By M. A. diFonzo. (*Algodon*, 115/116, 1944, p. 478. From *Summ. Curr. Lit.*, xxvii, 18, 1947, p. 348.) The geographical distribution in the world, and in Argentina, of the disease produced on cotton plants by the fungus *Glomerella gossypii* is analysed. The morphological aspects have been studied and experiments on the development of the disease are described.

The characteristics of the disease and its forms of propagation are considered, and common procedures for its control are discussed. The article is illustrated by tables, photographs and microphotographs.

89. COTTON MOULDS: TOXICITY. By M. V. Gorlenko. (*C.R. Acad. Sci. U.S.S.R.*, **54**, 1946, p. 449. From *Rev. App. Mycol.*, xxvi, 1947, p. 300.) Besides *Stachybotrys alternans*, the agent of a virulent disease of horses in the Ukraine, nine other ubiquitous moulds obtained from the air of cotton mills, from cotton-wool, and fodder samples, including *Alternaria tenuis* and *Macrosporium gossypii*, were shown to be more or less pathogenic to rabbits. Though the toxicity of the other organisms is lower than that of *S. alternans*, their growth is more rapid and prolific. All the toxins are readily soluble in acetone, ether, alcohol, and dichlorethane, but not in water. They are endotoxins, confined within the mould itself and not diffusing into the substratum, a matter of some practical importance, inasmuch as contaminated fodder can be freed from the superficial moulds and rendered fit for consumption—*e.g.*, by washing.

90. *Thielaviopsis* ROOT ROT OF COTTON IN MISSISSIPPI. By J. T. Presley. (*Pl. Dis. Rptr.*, xxxi, **4**, 1947, p. 152. Mimeographed. From *Rev. App. Mycol.*, xxvi, **10**, 1947, p. 449.) In the spring of 1945 and 1946, root rot, due to *Thielaviopsis basicola*, caused considerable loss of cotton seedlings, especially on the heavier soils in the northern part of Mississippi and in the Delta. The fungus was found in 30 per cent. of the diseased seedlings in certain fields. The first mature plants killed by internal collar rot caused by the fungus were observed in 1946. This rot results from seedling lesions, only partially healed, which become active again in early autumn. In Oktibbeha County more than 20 per cent. of the plants were killed in a localized area.

91. THE VIRUSES. By N. W. Pirie. (*Ann. Rev. Biochem.*, xv, 1946, p. 573. From *Rev. App. Mycol.*, xxvi, **5**, 1947, p. 183.) The present position of virus research is briefly surveyed in terms of three questions—namely: (1) whether viruses can be considered a group that is chemically and physically distinguishable from all other biological material; (2) whether there are general chemical differences between plant, bacterial, and animal viruses; and (3) the feasibility of virus classification. It is concluded from a perusal of the relevant literature (listed in a bibliography of 89 titles) that no chemical differentiation of viruses from normal tissue components is practicable in the light of present knowledge; they are recognizable only by their ability to induce definite physiological changes in the host, and not by their own intrinsic properties. It is of interest to note that the viruses are not known to infect gymnosperms, pteridophytes, and bryophytes. So many factors influence the direction of plant and animal virus research that differences in the results may not reflect genuine divergences between the two virus groups. Parallel studies on the viruses attacking plants, bacteria, and animals should be carried on wherever circumstances permit. All the classification systems hitherto proposed are open to various objections arising from imperfect knowledge of their morphological, chemical, and physical attributes. Other sections of the review are concerned with the tobacco mosaic virus, other plant viruses, associations between a virus and its host, and general methods of investigation.

92. CONTROL OF THE COTTON WILT DISEASE IN THE BELGIAN CONGO. By R. L. Steyaert. (*Sci. Mon.*, **63**, 1946, and *Not. Phytopath. Inst. Nat. Etud. Agron. Congo Belge*, **2**, 1945. From *Rev. App. Mycol.*, xxvi, 1947, p. 235.) Since *Fusarium vasinfectum* was found on cotton in the Belgian Congo at Bambesa in 1937, many foci of infection have been discovered; in most cases the primary infections have been traced to Wonder Dixie Triumph seeds imported from the United States. To retard spread, strict quarantine measures have been enforced on the propagation of seed within the Colony. Selection for resistance is progressing satisfactorily. Wilt is a serious threat locally, as climatic and soil conditions are near or within the optimum for the growth of the fungus throughout the year. For control purposes, the author recommends that in areas that have become affected only recently

the diseased fields should be isolated at once, the crop destroyed, and the area concerned placed under forest fallow. Only the heavy seeds obtained after floating in water and delinting in sulphuric acid should be exported.

GENERAL BOTANY, BREEDING, ETC.

93. Cytological Investigations on some of the Interspecific Hybrids of (American × Asiatic) × American Cottons and their Progenies. By N. K. Iyengar. (*Ind. J. Genet. Pl. Breed.*, **5**, 1945, p. 32. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 263.) Progenies have been raised by backcrossing F_1 hybrids between American and Asiatic cottons to American cottons. The chromosome numbers of the backcross progenies varied from $2n=50$ to $2n=80$, with modes at 52 and 65. Meiosis was fairly regular in the 52-chromosome hybrids, and these were in general highly fertile. Pairing was also good in the 50, 51, 53 and 55 chromosome hybrids, and the 50 and 51 chromosome plants tended to give rise to offspring with 52 chromosomes. Chromosome numbers from 53 to 67 were found in the progenies of the 65-chromosome backcross hybrids, and these plants varied considerably, both in meiotic behaviour and in gross morphology.

94. The Gene. By H. J. Muller. (*Proc. Roy. Soc.*, 1947, **134**, p. 1. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 257.) This article is a Pilgrim Trust lecture delivered in 1945, with supplementary notes; it is a general review of present conceptions as to the nature of the gene. To begin with, the evidence and *a priori* considerations for distinguishing genetics from non-genetic living material are set out, then the reasons for holding the theory that genes are single particulate aperiodic bodies linearly disposed along the chromosomes. The author favours the definition of the gene as the minimum amount of genetic material capable of individual self-duplication, though it is admitted that there may be difficulties in applying this definition. The factors influencing mutation rate are considered, and the random nature of mutation is emphasized. Passing on to non-nuclear genetics, consideration is given to plastid genes, plasmagenes, the *k* substance of Sonneborn, Darlington's theory on the origin of viruses, and Altenburg's viroid hypothesis. Generally speaking, it is thought unlikely that cytoplasmic genetical systems are of much evolutionary importance. Regarding the problem of increase in the number of genes throughout evolutionary history, the author is inclined to maintain that every gene has had its origin from a pre-existing gene. Special attention is given to the possible mechanisms of self-duplication of genes, and synapsis. Other subjects treated include the *Pneumococcus* transformation, the way in which the genes affect the life of the cell, the position effect, and the evolutionary significance of sex in bringing about the shuffling of genes. A final section is devoted to the sociological implications of genetics.

95. Theoretical Genetics and Plant Breeding. By A. Müntzing. (In Swedish. *Sverig. Utsädesfören. Tidskr.*, **56**, 1946, p. 582. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 283.) A concise survey is given of the development of genetical theory in relation to plant breeding from Darwin's time to recent work of Swedish and American investigators, with reference to discoveries relating to mutation, chromosome doubling, irradiation, colchicine effects, inbreeding and degeneration.

96. Plant Breeding and Genetics in India. By R. H. Richaria. See Abstract 5.

97. La Génétique et son Rôle en Agriculture. By R. de Vilmorin. (*C.R. Acad. Agr. Fr.*, **32**, 1946, p. 640. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 269.) An address to the French Academy of Agriculture in which the author reviews the progress made in recent years in the application of genetical principles to plant breeding. Hybridization, induced mutation and chromosomal aberrations, polyploidy and heterosis receive attention.

98. Genetic Techniques in the Development of Microbiological Assays. By G. Pontecorvo. (*Biochem. J.*, **11**, 1, 1947, xii-xiii. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 258.) The use of induced nutritional mutants in investigations on the bacteria and moulds is discussed with reference to the results of recent research.

99. Genetics of *Glomerella*. IV. Nuclear Phenomena in the Ascus. By G. B. Lucas. (*Amer. J. Bot.*, **33**, 1946, p. 802. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 297.) A description is given of nuclear behaviour in the ascus of several strains of *Glomerella* sp. There appear to be $n=4$ chromosomes. Fusion of two haploid nuclei occurs in the young ascus, and this is followed by reduction division and a further meiotic division to give eight haploid ascospore nuclei.

100. Lysenko's Genetica. By M. J. Sirks. (In Dutch. *Vakbl. Biol.*, **28**, 1947, p. 8. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 284.) A review is presented of Dobzhansky's English translation of Lysenko's article on "Heredity and its Variability," and a detailed discussion follows on "The New Genetics in the Soviet Union" by Hudson and Richens, in which Lysenko's scientific views are presented from the original sources and against their historical and political background. The author's own views on the "Lysenko problem" conclude the critique.

101. Work of Soviet Biologists: Theoretical Genetics. By N. P. Dubinin. (*Science*, **105**, 1947, p. 109. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 270.) A brief conspectus is presented of the contributions of Russian geneticists to modern genetical theory. Lists are included of the geneticists who have worked on the following: Population genetics and the mode of operation of natural selection; the origin of cultivated plants and phytogeographical researches; polyploidy, and wide crossing. Much work has also been done on the nature of the gene and the structure of the chromosomes. An interesting school of thought has developed under the ægis of Schmalhausen, working on the relationship between evolution and genetics, and on the evolutionary significance of adaptive modification.

102. A Revolution in Soviet Science. By C. D. Darlington. (*Discovery*, **8**, 1947, p. 40. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 256.) A brief review is given of the history of genetics in the U.S.S.R. from the foundation of the Lenin Academy of Agricultural Sciences to the present day, paying particular attention to the controversy between Vavilov and the Mendelian geneticists on the one hand, and Lysenko and his school on the other. The account is based principally on Dobzhansky's translation of Lysenko's "Heredity and its Variability," and "The New Genetics in the Soviet Union" by Hudson and Richens. The author criticizes strongly the whole basis of Lysenko's system, and expresses dismay at the extent to which it appears to have gained ascendency in the Soviet Union.

103. Heredity and its Variability. By T. D. Lysenko and T. Dhobzhansky (Translator). (King's Crown Press, New York, 1946. Reviewed *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 348.) Lysenko's opuscule on "Heredity and its Variability" was first published in 1943, and has been republished in Russia several times since. It has come to be regarded both in Russia and elsewhere as one of the most important expositions of Lysenko's views, and its translation into English should go far towards acquainting English readers with the substance of Lysenko's outlook. The problem confronting any translator of Lysenko is a thorny one. He is not an easy author to follow. His deliberate rejection of current genetic terminology has forced him to improvise his own terms, and his eagerness to get his views across to the workers on State and collective farms has led him to adopt words in everyday use, which he then employs with many and subtle shifts in meaning to express his own ideas. For the translator of Lysenko two alternatives present themselves. Firstly, he may translate word for word, reproducing the prolix and luxuriant style of the author, with its many repetitions, its fumblings and gropings for words in which to express ideas hitherto unexpressed, and its innumerable amplifications, digressions and qualifications in the endeavour to avoid misunderstanding. Secondly, he may translate rather more freely, reducing the style of the original to a more concise and readable form, and smoothing out the intricacies of the original so that the meaning can be grasped without excessive strain to the reader. These two methods may be termed logical and syntactical clarification respectively, and of these, Professor Dobzhansky, in his admirable and exceedingly useful translation of Lysenko's work, has tended to adopt the latter. While reproducing as

faithfully as possible the peculiarities of Lysenko's style, he has simplified the original somewhat, and has often translated by single words concepts expressed by Lysenko in two or more words of almost but not exactly the same meaning. By telescoping in this and other ways, a more readable text has resulted, and for anyone making his first acquaintance with Lysenko's writings, his task has been lightened. For those more deeply versed in Lysenko's theories, the position is less satisfactory. Lysenko's prolixity is partly due to the novelty of his ideas, and his torrents of words, his constant use of analogy, and his frequent reiterations must be viewed in the light of his search for a medium to express biological concepts unsullied by the suspect genetics of the West. Any attempt to clarify Lysenko's syntax acts to the detriment of its logical coherence, and it is perhaps fair to point out that in certain passages he appears rather more logical in his original Russian than in translation. However, it is hardly necessary to dwell on this point, since students of Lysenko must perforce read Russian, almost the entire corpus of the writings of his school being in this language. A warning is perhaps necessary in this connection on a possible misuse of Professor Dobzhansky's translation. "Heredity and its Variability" is only one of the very many expositions of Lysenko's principles. In some ways it is not typical of the whole; much of it is certainly unintelligible, except with some knowledge of the history of genetics in Russia during the past two decades. It is impossible to appreciate the significance of the greater part of his theories unless the background against which they emerged is understood. This matter has, however, been discussed at some length in a recent publication.

[*Cf.* Abstr. 114, Vol. XXIV of this Review.]

104. Anthocyanin Genetics of Cotton and Rice. By K. Ramiah. (*Ind. J. Genet. Pl. Bre.*, **5**, 1945, p. 1. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 263.) A review is presented of present knowledge on the genetics of anthocyanin pigmentation in cotton and rice. Tables are included of the phenotypic manifestations of the R_2 allelomorphs in cotton, and of the complex pigmentation patterns occurring in certain rice groups. Among the subjects discussed are the rival theories of pleiotropy and closely linked allelomorphism put forward for explaining the multiple effects of the various pigmentation series, also the various causes contributing to red leaf blight in cotton.

105. The Genetics of Blackarm Resistance. V. Dwarf-Bunched and its Relationship to $\mathbf{B}_1$. By R. L. Knight. (*J. of Genet.*, **48**, 1, 1947, p. 43.) In the F_2 of a cross between two American Upland (*Gossypium hirsutum*) types, Uganda B.31 and the Sudan variety 514, a number of markedly dwarfed "bunched-up" plants appeared. Investigation showed that normality as opposed to "Dwarf-bunched" depends on the presence of either of two duplicate genes, one dominant and the other giving an intermediate heterozygote. These genes have been called $\mathbf{D_a}$ and $\mathbf{D_b}$, the former deriving from 514 and the latter from Uganda B.31. 514 is of $\mathbf{D_aD_ad_bd_b}$ genotype, Uganda B.31 is $\mathbf{d_ad\ D_bD_b}$, Dwarf-bunched is $\mathbf{d_ad_ad_bd_b}$, and the heterozygote $\mathbf{d_ad_aD_bd_b}$ shows considerable variability with a range from dwarf to normal. The gene $\mathbf{d_b}$ occurs in Gambia Native (*G. hirsutum* var. *punctatum*) and in the American Upland varieties Uganda SP84, XA129 and Deltapine, but it was not present in all Upland varieties examined. The gene $\mathbf{d_a}$ is closely linked with (or possibly identical with) the blackarm resistance gene $\mathbf{B}_1$. Since *G. barbadense* types are of $\mathbf{D_aD_aD_bD_b}$ composition, $\mathbf{B_1}$ can be utilized in conferring blackarm resistance on this group. Its use within the *G. hirsutum* group is fraught with the danger of producing Dwarf-bunched types as the end-product.

106. Cotton Bollworm Control by Genes. (*Ind. Frmg.*, viii, **2**, 1947, p. 89.) Cotton research workers in India and elsewhere are paying increasing attention to the wild relatives of the cultivated Indian cottons with a view to the introduction from these of such economically useful characters as resistance or immunity to diseases, pests, and drought by transferring some of their hereditary elements or genes to the cultivated cotton. In the Cotton Genetics Research Scheme at Indore

particular attention is being paid to a wild cotton from Arizona and Mexico, *Gossypium thurberi* (*G. trilobum*) having 26 chromosomes, the same number as found in the cultivated Asiatic cottons. It is a strange-looking plant with very small bolls and seeds and without any lint, so much unlike the cultivated cottons that it was at first considered a different genus altogether, *Thurberia thespesioides*. This wild cotton has been reported from various places and from Indore to be completely immune to the attack of all species of bollworm. It crosses well with cultivated American and Asiatic cottons, and the resulting hybrid, though it flowers profusely, is sterile, due to lack of viable pollen formation. The chromosome number of its hybrid (26) with Asiatic cotton has been doubled by Harland, and Beasley in America through the use of colchicine, and the resulting hybrid, which has 52 chromosomes, is found to cross successfully with the cultivated Americans, also having 52 chromosomes. Similar hybrids have been successfully produced at Indore, and some preliminary observations on the bollworm resistance of the hybrid were made. It was found that the tender shoot tips, young and old flower buds of both the undoubled and doubled hybrids are immune to bollworms, but the bolls of the doubled hybrid are found to be attacked. The problem of the exact mechanism of the immunity of the flowers is being investigated. There are indications that immunity and susceptibility to bollworms might be mainly chemotropic responses for oviposition of the moth due respectively to repellent and attractive scents given out by the plant, especially from the petals—a fact well known in applied entomology. This problem of immunity of *thurberi* and susceptibility of the cultivated cottons has been studied elsewhere, and various plant characters, such as non-hairiness of plant parts, smoothness and smallness of the bolls, and non-palatibility of the seeds, have been supposed to confer resistance. Work on pests of wild cottons at Coimbatore has definitely proved that smallness of the boll has nothing to do with the immunity of *thurberi*, since other wild cottons with even smaller bolls are attacked by bollworms. It is unfortunately almost impossible to transfer the complete immunity of *thurberi* to the cultivated American cottons through the synthesized doubled hybrid of *thurberi* owing to the difficulty of eliminating the susceptible genes of the Asiatic component in the latter. This will be so because the 13 *thurberi* chromosomes pair only with the other set of 13 *thurberi* chromosomes and not with the Asiatic chromosomes, thus leaving no chance of the gene or genes for immunity crossing over from *thurberi* to the Asiatic set of chromosomes. A more fruitful line of work would be to transfer the immunity first to Asiatics through the sterile undoubled hybrid by crossing this latter back to Asiatics. Though the chance of getting this backcross may be remote every attempt is being made to achieve this. Once such a transferred Asiatic is obtained by crossing this to *thurberi* and doubling the chromosome number of this hybrid, the right kind of material for conferring the maximum of immunity to the American cottons will become available.

107. CHROMOSOMES: ELECTRON MICROSCOPY. By J. T. Buckholz. (*Science*, **105**, 1947, p. 607. From *Summ. Curr. Lit.*, xxvii, **16/17**, 1947, p. 333.) The electron microscopy of chromosomes is described and micrographs are presented in which the chromomeres or granules are shown attached to a supporting thread, and vary greatly in size, shape, and "transparency" to electrons. These granules are considered as parts of the genic elements.

108. NOTES ON THE CLASSIFICATION AND DISTRIBUTION OF GENERA RELATED TO *Gossypium*. By J. B. Hutchinson. (*New Phytologist*, **46**, 1, 1947, p. 123.) This account of genera related to *Gossypium* is in the nature of a supplement to the study of the taxonomy of *Gossypium* published elsewhere. It was undertaken primarily to complete the classification of species excluded from *Gossypium* on taxonomic and cytogenetic grounds, and to clear up the confusion that existed concerning the limits of *Gossypium*.

[*Cf.* pp. 276 and 296, Vol. XXIV of this Review.]

109. THE TERMINOLOGY OF POLLINATION. By J. R. King and R. M. Brooks. (*Science*, **105**, 1947, p. 379. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 294.) A short

review of the diverse definitions that have been put forward for the terms self, cross, close, and open pollination. The desirability for precision in this matter is indicated.

110. THE SLIGHTED ROLE OF SEEDS IN PLANT PHYLOGENY. By A. C. Martin. (*Amer. J. Bot. Suppl.*, **33**, 1946, p. 842. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 294.) It is stated that the internal structure of seeds affords a valuable insight into the course of angiosperm phylogeny. Twelve fundamental forms of seed development are recognized. Classification based on these forms cuts across the present systems founded principally on floral morphology.

111. COTTON PLANT SELECTION: INFLUENCE OF THE SOWER. By A. Bilquez. (*Cotton et Fib. Trop.*, **1**, 1946, p. 99. From *J. Text. Inst.*, xxxviii, **6**, 1947, A250.) A study has been made whereby cotton seeds from the same lot were sown at exactly the same time by two different persons. The results, presented in a graph, show that there is a marked difference in the period elapsing between the sowing date and the spreading out of the seed-leaves for seeds sown by the two sowers. The conclusion is drawn that all the seeds in blocks for comparative tests should be sown by the same person, and that observations made in selection tests on the earliness of cotton plants should refer to the date of spreading of the cotyledons rather than to the date of sowing.

112. COTTON PLANTS: DAMAGE ON SALINE SOILS. By B. P. Strogonov and L. A. Ostapenko. (*C.R. Acad. Sci. U.S.S.R.*, **54**, 1946, p. 365. From *Summ. Curr. Lit.*, xxvii, **19**, 1947, p. 394.) Leaves of cotton plants grown under soil conditions of varied salt concentration were analysed, and showed an ammonia content per 100 g. raw weight of leaves of 0·76 mg. for low salinity, 1·61 mg. for medium, and 8·56 mg. for high salinity. The salts cause a protein breakdown producing ammonia and simple amines, such as urea and thiourea, with accompanying toxic injuries.

113. CULTIVATED COTTON VARIETIES: NOMENCLATURE AND CLASSIFICATION. By G. Roberty. (*Coton et Fib. Trop.*, **1**, 1946, p. 47. From *J. Text. Inst.*, xxxviii, **6**, 1947, A250.) The Anglo-Saxon classification of cotton is considered to be insufficiently precise. It is suggested that Old World cottons be divided into the sections *arborea*, comprising the three species *G. obtusifolium*, *G. arboreum*, L., and *G. eglandulosum*, and the section *herbacea*, comprising *G. herbaceum*, L. The New World cottons are divided into three sections: the *fructicosa*, comprising *G. hirsutum*, Mill. and *G. latifolium*, Murr., the *insculpta*, comprising *G. barbadense*, L., and *G. peruvianum*, Cav., and the *coarctata* constituted by the single species *G. lapideum*. Each of these nine species corresponds to relatively precise agricultural and industrial, biogeographic, genetic, and morphological data. Tables are presented illustrating this statement.

114. ISHAN COTTON PLANT: FLOWERING PECULIARITIES. By J. Miege. (*Coton et Fib. Trop.*, **1**, 1946, p. 11. From *Summ. Curr. Lit.*, xxvii, **10**, 1947, p. 207.) A study has been made of the variations of the corolla of Ishan cotton with the season at Bouake (Ivory Coast). The weight of the corollas and the height and length of the petals decrease with the advancing season. The variation of the length of the style above the staminal column seems to be independent of environmental factors. The variations in the coloration and dimensions of the petal spot have also been studied, and a correlation between the intensity of the petal spot and the dimension of the flower has been found. At Bouake chasmogamic flowers are found side by side with cleistogamic flowers, often on the same plant. The number of cleistogamic flowers increases as soon as the dry season starts at the end of December.

115. PLANT INJECTIONS FOR DIAGNOSTIC AND CURATIVE PURPOSES. By P. S. Cooper. (*E. Afr. Agr. Jour.*, xiii, **1**, 1947, p. 37.) The use of a hypodermic syringe for plant injections in the diagnosis of mineral deficiencies is described. It is shown that patience and experience, with relatively little technical skill, are required, and that results are obtained rapidly and with a high degree of accuracy. The advantages and disadvantages of the methods used are discussed, the types of

syringes most useful for injection purposes described, and the additional equipment required listed. Three principal methods of injection are discussed, two referring to leaf injections and one to stem injections. . . . The type and strength of chemical solutions used for injections are given, and the effect of both chemical and mechanical damage described. A brief outline of the symptoms attributed to deficiencies of some of the major and minor elements is included, and the results of typical injection experiments described. As far as possible, all details relating to the physiological aspect of the injection methods are omitted, and the paper refers only to the type of injections as used solely in diagnostic work, no attempt being made to give the more complicated details necessarily associated with such injections.

116. POSSIBLE PRACTICAL METHOD FOR PRODUCING HYBRID SEED OF SELF-POLLINATED CROPS THROUGH THE USE OF MALE-STERILITY. By L. Smith. (*J. Amer. Soc. Agron.*, **39**, 1947, p. 260. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 285.) It is suggested that, since many male-sterile plants are fertile if grown under different environmental conditions from usual, it should be possible to obtain homozygous, fertile but potentially male-sterile lines of self-pollinated crops by growing them in suitable localities. They could then be transferred to regions where they are male sterile, and could thus be used for obtaining heterotic hybrids.

117. FIBRE AND SPINNING PROPERTIES OF COTTON, WITH SPECIAL REFERENCE TO VARIETAL AND ENVIRONMENTAL EFFECTS. By H. E. Barker and E. E. Berkley. (*Tech. Bull. U.S. Dept. Agr. No.* 931, 1946. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 324.) An analysis was made of the fibre and spinning properties of commercial cotton varieties and strains grown under irrigated and non-irrigated conditions in the Cotton Belt; the chief conclusion reached is that variety is a more important factor than the environment in its effect upon fibre qualities and spinning performance.

118. APOMIXIS IN HIGHER PLANTS. PT. I. THE MECHANISM OF APOMIXIS. By A. Gustafsson. (In Swedish. *Acta. Univ. Lund.*, **57**, 1946, p. 66. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 294.) A useful review is presented of the history of investigations on apomixis, on the terminology, and on the present state of knowledge on this subject. In addition to apomictic phenomena strictly speaking, an account is given of anomalous endosperm development, polyembryony, vegetative reproduction, and natural sterility.

119. HORMONES IN RELATION TO REPRODUCTION AND MUTATION. By E. C. Jeffrey. (*Amer. J. Bot.*, Suppl. **33**, 1946, p. 822. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 294.) It is claimed that parthenogenetic development of the ovum of higher plants induced by hormones emanating from pollen deposited on the stigma is far commoner than generally supposed. One result of the hormone stimulus is to cause duplication of the chromosome number of the ovum.

120. COLCHICINE TREATMENT TECHNIQUES FOR SPROUTED SEEDS AND SEEDLINGS. By L. P. V. Johnson and H. W. Holtz. (*Canad. J. Res.*, **24**, Sect. C., 1946, p. 303. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 258.) The problem of over-treatment of the root during colchicine treatment of sprouted seeds and seedlings in polyploid induction is emphasized. Techniques are described for treating sprouting seeds and spring seedlings with an aqueous colchicine solution, by means of which the stem is subjected to colchicine treatment without immersion of the root. The methods are considered to be applicable to most plant species normally produced by seed.

121. THREE USEFUL GADGETS FOR PLANT BREEDERS. By D. G. Langham. (*J. Hered.*, **38**, 1947, p. 29. From *Pl. Bre. Abs.*, xvii, **3**, 1947, p. 270.) Descriptions are given of the author's type of tag and stake for marking varieties in the field, of a form of tag in which string is replaced by fine copper wire which can be twisted around the stalk to be marked, and of a method of arranging seeds for exhibition purposes.

FIBRES, YARNS, SPINNING, WEAVING, ETC.

122. Cotton Cellulose: Changes Caused by Dyeing Procedures. By K. Brass and W. Schreier. (*Kolloid-Z.*, **108**, 1944, p. 155. From *Summ. Curr. Lit.*, xxvii, **5**, 1947, p. 98.) An attempt has been made to determine whether or not cellulose is altered on dyeing under varying conditions. The physical properties of the highly purified cellulose were determined prior to dyeing, and after the dye had been fixed to the fibre and then stripped quantitatively under the mildest conditions. The effect of the solvent used in stripping was also determined. Changes in relative and absolute viscosities and optical activity in cuprammonium solution, as well as specific gravity, were noted. Experiments were carried out with the substantative dyes, Benzopurpurine 4B and Chrysamine K, the vat dyes Indanthrene Blue RSN and Indanthrene Yellow, and with Naphthol AS. With the substantative dyes, changes induced by 1 per cent. dyeings, followed by removal of the dyes with pyridine, were insignificant. Only at higher concentrations of these dyes were there slight changes, due possibly to a chemical reaction between the dyes and cellulose. With vat dyes, determinations had to be made on the fibre solutions and were compared with controls. Significant changes in the properties led to the conclusion that presumably cellulose reacts chemically with the vat dye. Cellulose treated in the same way as for vat dyeing only in the absence of the dye itself also showed significant changes. The development of the ingrain red colour of Naphthol AS caused appreciable changes in cellulose. Detailed tabulated data are given.

123. Fibres: Tensile Strength. By L. van Iseghem. (*Textielwezen*, **1**, Nos. 4-7, 1945. From *Summ. Curr. Lit.*, xxvii, **11**, 1947, p. 235.) A brief review of methods and apparatus for measuring the breaking load of fibres, including testers due to O'Neill (1865), modified by Y. Henry (1902), and by Balls and the Shirley Institute, dynamometers due to Heim (1922), Matthews (1924), and Barratt, and a new dynamometer called "Fibro" made by Etab. M. Defraine, Brussels.

124. An Instrument for the Measurement of the Forces Operating between Fibres during Drafting. By J. G. Martindale. (*J. Text. Inst.*, xxxviii, **3**, 1947, T151.) A description is given of the apparatus, which consists of a small draw-frame, the front rollers of which are held in a spring-mounted cradle so that the deflections of the cradle indicate the forces required to effect the drafting of the sliver or roving being passed through the frame.

125. Cotton Fibre: Structure. By H. Dolmetsch. (*Textilberichte*, **26**, 1945, p. 23. From *Summ. Curr. Lit.*, xxvii, **18**, 1947, p. 361.) Studies of the swelling of physically and chemically pre-treated cotton showed that the cotton fibre is constructed similarly to the staple rayon fibre. The separation of the secondary layer into lamellæ, fibrils, and spiral surfaces is possible without any appreciable degradation of the cellulose. The lamellæ can be separated most readily by the extraction of low-polymer intermediate layers. The fibrils can be isolated mechanically by squeezing, or chemically by still unknown reactions which occur during the reaction of hydrazine hydrate and other reducing agents. The spiral surfaces can be separated only chemically by the degradation of an easily hydrolysable intermediate layer.

126. Cotton Fibre: Sampling for Testing. By J. E. Caramelli. (*Algodon*, Nos. 125-126, 1945, p. 389. From *Summ. Curr. Lit.*, xxvii, **18**, 1947, p. 361.) Attention is drawn to the wide limits between which cotton fibre properties fluctuate, and the resulting difficulty in obtaining representative and uniform samples for laboratory analyses, as well as the danger of drawing inadequate conclusions from non-uniform samples. A table is given of extreme values of cross-sectional area, perimeter, lumen, length and breaking load in a typical sample.

127. Byssinosis: Occurrence among Cotton Operatives. By C. I. C. Gill. (*Brit. J. Indus. Med.*, **4**, 1947, p. 48. From *Summ. Curr. Lit.*, xxvii, **16/17**, 1947, p. 346.) An illustrated account is given for the benefit of medical men of the

processing of cotton in the blowing and card rooms, and of the symptoms, radiographic appearances, and prevention of the respiratory disease known as byssinosis. The work of Prausnitz (1936) on the causative agent is briefly reviewed.

TRADE, PRICES, NEW USES, ETC.

128. COTTON: WORLD PRODUCTION AND CONSUMPTION DURING THE WAR. By E. Senn. (*Coton et Fib. Trop.*, **1**, 1946, p. 3. From *Summ. Curr. Lit.*, xxvii, **10**, 1947, p. 227.) The consumption and production of cotton in the world during the years 1939 to 1945 are analysed and figures are presented. The position for the year 1945-46 is reviewed, and reference is also made to the development in the production of rayon and staple fibre. It is pointed out that the great cotton-producing and exporting countries have come out of the war as creditors, whereas the former main cotton importers are indebted and their economies seriously shaken. The demand for cotton products in the world has increased immensely, whereas the production of cotton has been decreased. Cotton prices are no longer governed by the laws of supply and demand, but depend on governmental decisions. The immediate outlook for the cotton industry in the world is discussed.

129. WORLD COTTON CONSUMPTION EXCEEDS CROPS. (*The Ambassador*, October, 1947, p. 129.) For the second successive season world cotton production in 1946-47 was on the decline, while consumption was on the increase. The season's crop (according to the International Cotton Advisory Committee) was at the level of 21·5 million bales for the year ending July 31, 1947; this is not quite 70 per cent. of the pre-war annual average of 31 million bales. Meanwhile, during the same period, world consumption of cotton totalled some 27·5 million bales; this was a fair increase upon consumption in the 1945-46 season, at 24·03 million bales, and 95 per cent. of the pre-war annual average of 29 million bales. Thus, the discrepancy between world cotton production and consumption continues to increase. The result is that world stocks of raw cotton, which on August 1, 1945, reached an all-time peak of 28 million bales, are being rapidly scaled down; the reduction at the end of the current season is estimated at 6 million bales from the total on August 1, 1946. This means that cotton stocks in all countries are now at the level of 17-18 million bales. In normal times this would be a substantial carry-over, but with production running at such a low level it may not be sufficient to prevent a tight supply situation by 1948.

130. NEW USES FOR COTTON. (*The Ambassador*, July, 1947, p. 162.) Among the new uses for cotton reported in the U.S. Dept. of Labour publication, "Summary of Current Technological Developments," is the use of cotton duck for insulation in railroad refrigeration cars and even in the home. The cotton insulant in the railroad cars is a ton lighter than that formerly used; in the home, duck experimentally installed is still intact after five years of service. Other recent new techniques involving cotton include the production, from cotton fibres and resin, of a light, strong, colourable plastic structural material; the weaving of rough, cheap Osnaburg into a soft fabric; and the evolution of a new method of waterproofing cotton, the use of which may also be extended to wool. "Cottontex," which is still in the experimental stage, is said to be capable of replacing wool for any purpose; it is claimed to be proof against warping, sagging, and swelling.

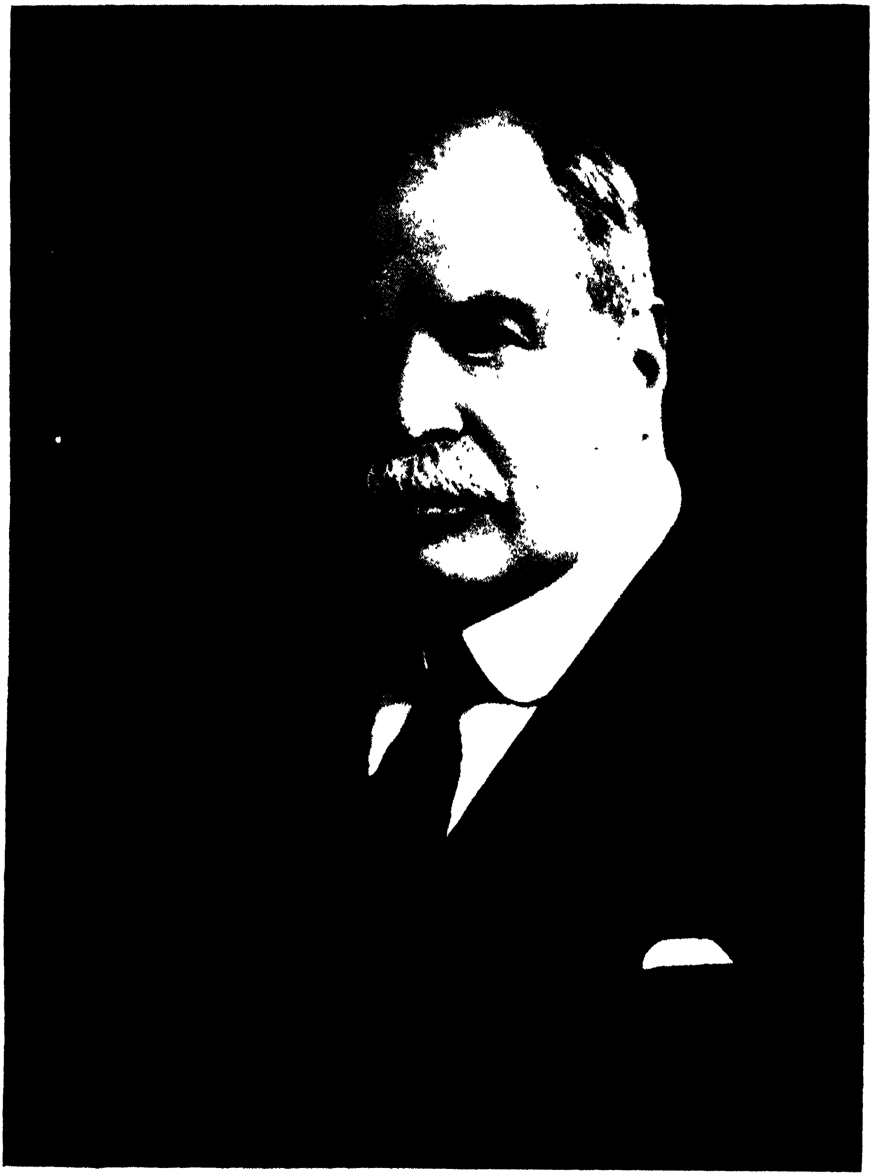
131. NEW USES FOR COTTON. By H. T. Herrick. (*Sci. in Frmg.*, U.S. Yrbk. of Agr., 1943-47, p. 689.) At the Southern Regional Research Laboratory it is stated that by means of a modified mercerization process developed at the laboratory, standard cotton gauze may be made semi-elastic and used to advantage in bandages for several types of injuries. This new all-cotton material will bend and give with the flexing of a joint, will expand if there is swelling, and is liked by doctors and nurses, particularly for cases where a mild-pressure dressing is required. About 30,000 rolls of the bandage have been produced at the Southern Laboratory, and used in clinical trials by Navy, Army, and private hospitals.

MISCELLANEOUS

132. Research: A Journal of Science and its Applications. (Published, Butterworth's Scientific Publications Ltd., Bell Yard, Temple Bar, London, W.C.2, 1947. Price 3s. 6d. per copy. Annual subscription, including postage, £2 5s. in U.K., \$10 in U.S.A.) We have received a copy of the first number, issued in October, of this new monthly research journal, edited jointly by Dr. R. Rosbaud and Mr. D. R. Rexworthy, with the assistance of a strong Scientific Advisory Board under the chairmanship of Sir John Anderson, with Prof. R. S. Hutton as secretary. Sir John Anderson has contributed the editorial article in the first issue, and in subsequent numbers this article will be written by members of the Scientific Advisory Board or other leading men of science. The first number contains the following main articles: "Diamond Dies for Wire Drawing," Sir Clifford Paterson; "Chemical Regulators of Plant Growth," Dr. M. A. H. Tincker; "Metallic Creep," Dr. A. H. Sully; "Polarographic Cystine and Protein Tests," Dr. R. Brdička; "British Scientific Instrument Research Association," Mr. A. J. Philpot.

In scope, *Research* will be found to differ materially from any other journal. It is not a journal of pure research. It will not specialize, for it favours no particular field of endeavour; still less will it be found to compete with the technical and trade journals. The selection of matter to form the main features of the journal will require a continuous review of developments in all branches of science throughout the world. Those developments which may have, sooner or later, significant practical application, will be chosen as subject matter by a highly competent editorial staff working in close association with the Scientific Advisory Board. New discoveries, new applications, new techniques, will all have a place. Descriptions will be given so far as practicable in non-specialized language. There will be reviews of published works, and an appropriate amount of space will be devoted to correspondence. Important developments not yet ripe for general treatment as descriptive reviews will find their place as original research papers in the Research Supplement. It is hoped that the journal, and the activities connected with it, will help not only to enhance the efficiency of British production, but also to establish Britain in a position of recognized leadership among the countries of Europe in science and in the field of scientific publication. We wish every success to the journal in its endeavour to forge a link, in a practical and purposeful manner, between fundamental science and its applications in industry and elsewhere.

Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher



[Photograph by Van Dyk

THE RT. HON. THE EARL OF DERBY, K.G., G.C.B., G.C.V.O.

President of the Corporation, 1921 to 1945
Patron: 1945 to 1948

THE EMPIRE COTTON GROWING REVIEW

VOL. XXV. APRIL, 1948 No. 2

AGRICULTURAL RESEARCH IN EAST AFRICA

In the late Lord Derby's last address as President of the Empire Cotton Growing Corporation, quoted elsewhere in this issue, he stressed the necessity of co-ordinating the work of the Corporation's new research undertaking, centred at Namulonge in Uganda, with the official schemes then in course of preparation for extending and improving research work in the Colonial Empire.

From this point of view we have a special interest in the proceedings of the widely representative Nairobi Research Conference held last year, some account of which is now available in the October, 1947, number of the *East African Agricultural Journal*. The Conference was in two parts: an Organization Session under the Chairmanship of Sir George Sandford, Chief Secretary to the East African Governors' Conference, and a Technical Session of which the Chairman was Dr. E. B. Worthington, Scientific Secretary to the same body. The Empire Cotton Growing Corporation was represented by Mr. F. R. Parnell and Mr. A. N. Prentice. There was a fully representative attendance of Agricultural, Veterinary and Forestry Officers from Kenya, Uganda, and Tanganyika, with the Acting Directors of Agriculture of Zanzibar and Nyasaland also present. Inter-territorial research organizations took part and Imperial Chemical Industries and the United Africa Company were represented. Dr. H. H. Storey, Secretary of the Colonial Agricultural Research Committee, represented the Colonial Office.

The Organization Session dealt mainly with the establishment of an East African Agricultural and Forestry Research Organization which is to be one of the common (*i.e.*, inter-territorial) services administered by the East African High Commission, a new body superseding the Governors' Conference from January 1 this year, and providing the nearest approach considered practical at present to the " closer union " so long discussed. The Research Organization is to take over and expand the functions of the East African Research Institute based on Amani, in Tanganyika Territory. The title " Institute," rejected on high authority at its inception in 1926, recently displaced " Station," and is now itself to be displaced by " Organization." This change is

presumably intended to imply a more comprehensive and a looser structure, less associated with a local habitation and a territorial name.

The Research Institute has from its foundation occupied without alternative the land and buildings at Amani of its German East African predecessor the *Biologisches und Landwirtschaftliches Institut*, and has secured thereby a seclusion which, from a scientific if not from a social point of view, has not been without advantage. Though charged with the duty of carrying out fundamental research on a continental scale, its staff was never more than a skeleton, development being arrested by the financial stringency of the times. In response to needs considered more urgent most of its members were widely scattered during the recent war and have not been reassembled. A post-war offshoot, for cinchona research, has come to a premature end and affords some recruits for the new organization. A Director of distinction in research and wide agricultural experience, Dr. B. A. Keen, F.R.S., has taken up his post and is eventually to occupy new headquarters near Nairobi. The technical staff are to remain for the time being based on Amani, where laboratory space and equipment, an excellent library, and the necessary housing accommodation are already in existence. As the first project of the organization, a team is being formed from available staff to work on fertilizer experiments with food crops, with the object of finding out how the productivity of the soil can best be increased.

Although the gestation of the East African Agricultural and Forestry Research Organization has covered a period of several years—which we may hope presages the eventual development of an organism of imposing stature—we are not aware that any official definition of its intended scope has yet been made public. It would appear from such indications as are available that there will be less restriction to fundamental research than was necessary when its practical applications were assumed to be the jealously guarded prerogative of the territorial departments. In the report on which we have based this article it is stated that under the new research scheme much of the work will be carried out in field stations adjacent to, or on part of, departmental experiment stations, and close contact between specialist and field officers is anticipated. Such a policy could quite naturally include similar relations with an extra-official station such as Namulonge, and thus bring the Organization into a relationship—more or less intimate according to circumstances—with the Corporation. It should be safe to assume that the Organization, with its heavy load of responsibilities, will welcome the co-operation which the Research Station can offer in the range of its special interests.

At the opening of the Technical Session, the Chairman stated that the main reason for holding it was to give opportunities for members to express their opinions on problems which were likely to be investigated

by the new research organization. Collaboration between agricultural, veterinary, and forestry research organizations and territorial departments could best be assured by discussions between the officers concerned in order that they should obtain a wider view of the work involved. He emphasized that the results of discussions on these technical subjects would be of great assistance to the Director of the East African Agricultural and Forestry Research Organization in forming his research programme.

The wide range of the subjects under discussion in this Technical Session can best be appreciated by quoting the agenda:

1. The need for ecological, soil, land utilization, and social surveys on an inter-territorial basis.
2. Biological and physical conditions in tropical and sub-tropical soils.
   (*a*) The organic-matter cycle and soil fertility.
   (*b*) Soil structure in relation to moisture, etc., and plant growth.
3. The fundamental basis of mixed farming.
   (*a*) Animal husbandry and " pasture " (fodder) research.
   (*b*) " Pasture " improvement in relation to grazing and management and nutritive value.
   (*c*) Effect of different systems of pasture management on yield of arable crops.
   (*d*) Problems of leguminous crops.
4. Plant food status with special reference to the action of inorganic and organic fertilizers.
5. Mechanized farming and the need for investigation.
6. East African Agricultural and Forestry Journal.
7. A " Flora " of East Africa.

Most of these matters have a direct and fundamental interest in relation to cotton growing. As regards the first item, the usefulness, in a region where so many areas of undeveloped land exist, of surveys of the types mentioned is self-evident, but the vastness of the undertaking involved must make their realization a long-term process. A commencement has been made in the existing East African Soil Map, and it was suggested that soil reconnaissance should have a high priority in order to elaborate it, further define the soil types and relate them to petrology and vegetation. Such information is essential to the successful extension of agriculture into new areas. It was felt that soil survey in its more intensive sense would of necessity be restricted to relatively small areas after they have been selected for development schemes. Dr. Keen brought out the point which has been made by contributors to this Review, that effective application of land use surveys requires powers of persuasion practically amounting to compulsion.

The consideration of Item 2a, the Organic Matter Cycle and Soil

Fertility, included a note by Mr. F. R. Parnell, which he summarized in the discussion in the form of a series of questions: What happens to the organic matter in the soil? What do we know of the possibility of quite small amounts of organic matter modifying the physical soil conditions? Has organic manure any functions other than those of supplying plant nutrients? Is it true that it is not possible to build up the content of soil organic matter under tropical farming conditions? Is the nature of added organic matter important? Why do some soils lose their fertility almost at once when the natural forest cover is removed, whereas others, under similar treatment, remain fertile for many years?

That these questions of fundamental importance to tropical agriculture remain questions, and that attempts to answer them must at present be partial, local, and hesitant, gives the strongest indication of the practical need for research and of directions it should take.

On Item 2b, Soil Structure in relation to moisture relationships, nutrient status, and plant growth, discussion centred round Dr. W. S. Martin's work on grass rotation and crumb structure in African soils. Martin's conclusions were largely accepted in respect of certain types of soil, but for other types they either require modification or do not apply. It was recommended that the complex relationship: soil structure—organic matter—plant nutrient supply—water, merits early study which should cover various soil types and climatic conditions. This study should largely lie in the field. It was recommended further that a study of cultivation implements and the methods of their use should be included in the programme.

Under Item 3d, Dr. Keen pointed out the necessity which exists for investigation of the use and effects of leguminous plants in tropical agriculture. It cannot be assumed that the existing body of knowledge on this subject relating to temperate countries can be applied under different conditions, and there is evidence that important differences exist.

The subject of soil fertility was further pursued under Item 4, Plant Food Status with special reference to the action of organic and inorganic fertilizers. Dr. Duthie said that while we assume that the other major plant nutrients are straightforward in action, so that their use can be directed by means of chemical analysis and field experiments, the action of phosphates raised complex questions, and required much further study under tropical conditions. Active steps were being taken to initiate soil and plant analysis complementary to field fertilizer trials and to undertake a special study of the fertility status of East African soils with primary emphasis on phosphates.

The deliberations of the Conference emphasize what was already obvious enough, the enormous field of operations which lies open, far wider than the visible range of even the most ambitious schemes for

research. There are two immediate problems of organization, apart from any difficulties of finance and manpower; first, the relationship of the research organization to the various territorial departments, which have hitherto maintained, to some degree, their own scientific staffs, occupied mainly with *ad hoc* investigation and advice, and, second, the selection and method of the investigations first to be pursued. Great interest will attach to any statement in which decisions on these matters are announced, and we may hope they will not be much longer delayed.

DIRECTION OF RESEARCH

"Scientific research cannot really be organized under department leaders, who are themselves working scientists carrying out research work. The fact is that the unit of scientific research is a *scientist* with a group of assistants and he is, by definition, capable of directing his own work by his own methods. In the operation of his work he must be independent of all control and free to do whatever he wishes. The function of his superior in the organization is not to control the operation of the work; it is to direct the work toward the problems that seem most desirable, to insure and assist co-operation between the individual research units, to provide the necessary working conditions and environment, and, in an industrial laboratory, to see that any results obtained are applied in practice. This cannot be done by a man who is himself interested in his own scientific work, since he will inevitably devote himself to research on certain problems, using some members of the department as assistants and leaving the rest of the department without control. . . . The true analogy of a scientific research organization is not an army; it is an orchestra. . . . It is not the duty of the laboratory head to command his scientific staff; it is his duty to lead it."

(From "The Path of Science," by C. E. K. Mees, Director of Research of the Eastman Kodak Company.)

LORD DERBY

It is with the deepest regret that we have to record in this issue the death on February 4 of Lord Derby, who was President of the Administrative Council of the Corporation from the time when it received its Royal Charter in 1921 until 1945, when his health made it incumbent on him to reduce his responsibilities. On resigning the Presidency of the Council he was invited to become Patron of the Corporation, an office which he continued to fill up to the time of his death.

A mere relation of the facts summarizing Lord Derby's association with the Corporation can, however, of necessity tell very little of the value of his services to its work. When the selection of the first officers of the Corporation came to be considered, many names were mentioned as possible Vice-Presidents, but for the office of President it was fully realized that only one choice was possible, if Lord Derby would accept nomination. Ready at all times to do his utmost to further any project which he was satisfied would be of benefit to Lancashire, Lord Derby had already shown his interest in the promotion of cotton-growing in the Empire by accepting the Presidency of the British Cotton Growing Association on the death of Sir Alfred Jones, and he was good enough to consent to fill the corresponding post in the Corporation also.

As his speeches at successive Annual Meetings of the Corporation showed, its object appealed to him strongly, not only as an important step towards safeguarding the supply of raw cotton to this country, but because he believed that the extension of cotton-growing in the Dominions and Colonies would increase their prosperity and strengthen the bond between them and the mother country. Throughout his public life Lord Derby showed himself to be a firm believer in the future of the British Commonwealth of Nations, and any movement which he considered would enhance the brightness of that future was assured of his sympathy and powerful support.

At an early meeting of the Corporation he said: "I do not pretend that I can take any daily part in the work, but I can assure you that I have its interest very deeply at heart, and anything that I can possibly do to assist it is at the disposal of the executive." Nor was it long before he was giving a practical implementation of that promise, for in 1922 he headed a deputation to Lord Balfour, then Secretary of State for Foreign Affairs, representing the Corporation and other interested bodies, to impress on the Government the desirability of the early completion of the Blue Nile dam and the Gezira irrigation scheme in the Sudan. The deputation received a most reassuring reply; the

construction of the dam, then temporarily suspended, was pushed forward vigorously, and the result was the establishment of cotton-growing under irrigation on a large scale in the Sudan, which has brought prosperity to that country and done much to provide Lancashire with a satisfactory source of supply of long-staple cotton.

In spite of his disclaimer of his ability to take any regular part in the Corporation's daily work, Lord Derby asked to be kept in close touch. When important questions of policy were under consideration his views were invariably sought, his wide experience of men and affairs was always at the Corporation's disposal, and there were many occasions on which they reaped the benefit of his sound judgment.

A note which he repeatedly stressed in his speeches was the value to the cotton industry of far-reaching research work extending from the growth of the raw material to the finished product. " In the last twenty years," he said on one occasion, " our principal industries have realized that their research departments are their best investment." He accordingly gave a warm welcome to the Corporation's decision reached during the war to concentrate their research activities, as soon as circumstances permitted, in the new Central Cotton Research Station which they are now erecting in Uganda. He followed with interest the course of the discussions with the Colonial Office and the Government of Uganda on the provision of finance and the selection of a suitable site, and it was a matter of much satisfaction to him that, at the Corporation's Annual Meeting in 1944, the last review of the year's work that he presented before relinquishing the office of President of the Council contained an announcement that a suitable site for the Station had been found. His concluding paragraph on that occasion may perhaps be appropriately recalled as indicating his sympathy with and belief in the policy towards research work that the Corporation had decided to follow: " The work in preparation for which we are now laying the foundations holds high possibilities for advancing our knowledge of the cotton plant and improving it as an economic crop. It is accordingly of the greatest importance that we should make the best use of the time that is available before our plans can be carried into effect. We are seeking to ensure therefore that our work should be so organized as to fit in appropriately with other schemes now in course of preparation for extending and improving research work in the Colonial Empire in all branches of knowledge, which is to be an outstanding feature of this country's policy after the war."

Lord Derby's great services to the nation as a whole have already been widely recognized in the public press. We are only concerned here to record with sincere gratitude the valuable help that he was ever ready to give to our Corporation. This was achieved as much through his unique personality as by the pains he took to maintain touch with any

work with which he associated himself. There could indeed be no more apt tribute to his memory than the words used by *The Times*, where it was said: "There never was a great English aristocrat who more easily combined accomplishment with the common touch." It was his great gift of winning the confidence of men in every rank of life which gained him the respect and personal regard of all those who were privileged to come into contact with him.—L. G. K.

THE PLACE OF PLANT PHYSIOLOGY IN CROP RESEARCH

BY

V. H. BLACKMAN, Sc.D., F.R.S.

PLANT physiology is the study of the mechanism of the living plant and of its responses to changes in the external conditions of soil and climate. Some knowledge of this branch of physiology would thus seem to be a part of the essential equipment of any investigator who attempts, however sketchily, to view the plant as a working whole and to relate the results in his own special field to those of his fellow investigators.

In the ordinary *specialist* team for crop research on the biological side—plant breeder, pathologist, entomologist and plant physiologist —the last-named should be, not only an indispensable member of the team, but also a link between the other specialists. The pathologist and entomologist are concerned with a particular aspect, that of disease; the interest of the physiologist (of the right training and type) is with the normal plant; and the effects of the disease studied by his colleague should be related to the behaviour of that plant. Disease at an early stage of development though occasioning only slight damage, may markedly lower yield by reducing some part of the plant's " make-up " responsible for yield, such as flowering and fruiting branches. Conversely, heavy damage at a later stage may have little effect; as when the crop-producing mechanism is already established, or the parts lost, though active, no longer supply material to the fruit-producing system (*i.e.*, mature leaves of barley which translocate no material to the fruiting axis). It would seem, therefore, very evident that the plant physiologist can play a considerable part in relating to crop yield the results of the pathologist and entomologist. There is also another role which the physiologist can play—that of the aider and abettor of those studying disease. For the manifestations of parasitic disease, whether of fungus, insect or virus origin, are the result of interaction between the physiological processes of the parasite and those of the host plant. In the case of insects which prey upon plants, entomologists generally recognize that insect physiology should march with plant physiology. Again, the work of the plant breeder can hardly be carried on in independence of the physiologist. The latter with his knowledge of the behaviour and responses of the variety or varieties already in cultivation should be a valuable consultant as to the characteristics demanded of new forms.

Type of Plant Physiological Work for Crop Research

When plant physiology revived in this country in the second half of the nineteenth century it had little or no contact with agriculture. The subject became in the main one of *plant processes*—assimilation, respiration, transpiration, etc.—generally studied on isolated parts of plants and under artificial conditions in the laboratory. The results obtained were necessarily far removed from the problems of agriculture, concerned as they are with the plant as a whole growing under outdoor conditions or in a glasshouse. There may, of course, come a time when our knowledge of individual plant processes is so extensive that from it some conception of the plant as an integrated working whole can be built up; but that day is far distant. Furthermore, to build up such a picture much more must be known of the interrelationship of the processes, how one process affects another; this again is an almost unknown field.

Accepting, as it appears one must, the comparative leanness of the contribution which laboratory studies in plant physiology can make to the investigation of crop yield, the question arises as to whether the laboratory cannot be supplemented by a more immediately fruitful method of attack. The answer to this is the development during the last thirty years of the modern technique of *crop-analysis*, in which the physiological behaviour of the crop is studied directly in the field. Previous to the development of this mode of crop investigation,* the agriculturist, experimenting with, say, a fertilizer, knew hardly more than that a certain treatment gave a change in yield. Little knowledge was available as to how an increased yield was built up, whether by general augmentation of the plant body, or by an enlargement of the leaf surface, or by a higher efficiency of each unit of leaf surface, or by increase in the number of flowers, or by some development of the root system.

By the use of the technique of crop analysis such questions can be answered; for the method consists of sampling the crop regularly (say, fortnightly) throughout the growing season. There is, of course, the labour of collection and enumeration, but apart from this the scientific equipment required is of the simplest—drying ovens, a balance, a foot rule, and sometimes a planimeter. By the use of such equipment, and the regular collection of appropriate samples in the numbers required to give significant data, measurement can be made of the rate of increase in height, the rate of increase of total dry weight, the rate of increase of leaf-area, the rate of tillering (if

* Balls had previously stressed the need for quantitative data in the study of crop development, but the inception of the method of crop analysis is due to Gregory. (F. G. Gregory, "Physiological Conditions in Greenhouses." *Annual Report, Experimental and Research Stations.* iii, 19, 1917.)

any) and of the production of flowering shoots; and these can be combined with the rate of production and shedding of flowers and fruits. In some cases development of the root system can also be determined.

By measurements such as these a broad picture of the plant as a developing system is obtained and its responses to specific treatments brought out. When the crop analysis method is combined with the modern multifactorial system of field trials and modern methods of statistical analyses, not only can the interaction of factors (such as date of sowing, spacing, application of fertilizers) affecting yield be established, but the interaction of such factors in the growth and build-up of the plant can also be determined. Some examples are given below of the contributions to agriculture and crop research which have been made by plant-physiological investigations, and in particular by those of the crop analysis type.

Cotton in the Sudan Gezira and in Egypt

The region in which crop physiology has been most actively pursued is in the Sudan Gezira, where, under the direction and guidance of the late Frank Crowther,* great advances have been made in our knowledge of the physiology of cotton, an irrigation crop in this area. F. Crowther was an expert in the sampling method of crop analysis, and also skilled in the technique of modern field trials and in the application of statistical methods to the analysis of results. Some experiments with cotton were also carried out by him in the Nile Delta, which served as a valuable basis of comparison with those from the Gezira. It is interesting that it was in the Sudan Gezira that the first multiple-factor field experiments with cotton were carried out by Gregory, Crowther and Lambert[1] (1929-30 and 1930-31). There had, of course, in the past been numerous single-factor trials, but those in question were the first to be designed to show not only the effects of single factors but also the *interaction* between these factors. It cannot be said moreover that the work was mainly physiological, but *its impulse came from plant physiology*, and two of its authors were plant physiologists who wished to know how far the interaction of factors observed in plant processes would also show itself in the determination of crop yield. If there were such interactions the agricultural implications would be obvious.

These multifactorial experiments were most elaborate, with four sowing dates, three spacings, two nitrogen applications, and three levels of water applications. All the single factors were found to have significant effects, and when considered *in pairs* all the factors had interactions except sowing date and water. Among the interactions

* F. Crowther, at the time of his death in 1946 at the early age of 40, was Head of the Plant Physiology Section of the Research Division of the Department of Agriculture and Forestry, Sudan Government.

observed were: spacing has little effect with early sowing but a large effect with late, and this difference is independent of nitrogen; August sowing gives the highest yield with or without nitrogen; water supply with early sowing but without nitrogen has little effect, but with nitrogen a large effect; yield for nitrogen application declines with sowing date.

The work on the manuring of cotton in the Nile Delta,[2] carried out by F. Crowther in 1934-36 also shows what can be done by the physiological approach to field problems. The method of crop analysis was used, the response of the plant throughout the growing season being thus brought out and the mechanism by which crop yield is built up made evident. Field experiments of the multiple-factor type were employed (two experiments in 1934, six in 1935 and eight in 1936) to study the effects of nitrogenous and phosphatic manuring at different levels, at different sites, and on a number of varieties at various spacings. It was found that the amount of vegetative growth, whether measured by height or node number, had little relation to yield but there productive growth was all-important. Yield differences between different sites was largely determined *by the position of the fruiting branches up the stem and the distribution of fruit along them.* Excessive boll-shedding early in the season (May-June) did not seriously reduce yields where the *later-formed fruits could mature,* but if the conditions at a site were unfavourable and there was late loss, the yields and the yield response to manuring, were definitely lowered.

The variety-manuring relationship was found to result from an effect upon the fruits rather than upon the vegetative growth of the plant, the nitrogen effect being upon *fruit-number* and the phosphate effect upon *fruit-size.* The variety Giza 7, in response to *nitrogenous* manuring, gave a greater number of additional bolls (*i.e.*, additional to the unmanured) than Marsad. The latter variety on the other hand responded to *phosphate* manuring by giving a greater increase of seed cotton per boll than did Giza 7. In general, compared with variety, all other factors controlling manurial response were unimportant. A striking relationship was found between (*a*) season, (*b*) spacing, and (*c*) response to manuring. In 1935 close spacing was the best for yield. In 1936 there was no such pronounced optimum, and to this the physiological-botanical data supplied the explanation. In 1936 a seasonal factor (possibly cool weather in May and June) brought about prolific fruiting at the *lower zones* of the stem and so allowed the plants of the *wide* spacings to begin early to make up for their smaller population. This gave them compensation for the larger number of the plants of the *closer* spacing, with the result that there was no marked optimum as in 1935, and all spacings gave similar

yields and similar responses to manure. In 1935 fruiting at the *lower zones* of the stem was restricted in plants of all spacings so that those of the closer spacings by weight of numbers gave the greater yield. Since manuring led to extra fruiting in the *middle and upper zones* of the stem—the manuring effect on growth is always delayed —the closer spacing this year gave also greater response to manuring. Thus the effect of weather upon the distribution of fruit on the main stem of the cotton plant is shown to elucidate the variation from season to season, not only of the spacing optimal for yield, but also of that optimal for manurial response. It can surely be claimed that data such as these are fundamental to our knowledge of crop response and that no scheme of crop research could be considered adequate which failed to make provision for such investigations.

Employing the same method of crop analysis, F. Crowther[3] made a most interesting comparison between the cotton crop in the Nile Delta and in the Sudan Gezira. The crops are sown at very different dates in the two experimental areas (which are 1,500 miles apart), but by using results from the same time-intervals from sowing comparable data are obtained. When the rate of leaf growth (increase of dry material per square metre of field) is compared in the two areas it is found that the same *maximum* is reached in both, though the early growth is much more rapid in the Sudan than in Egypt. The rate of growth is kept down in Egypt by the low temperatures in March and April, and Balls[4] showed the controlling factor in Egypt to be low night temperatures. In the Sudan the conditions are very different, for the cotton is sown when day temperatures are moderate and the nights are warm. In Egypt the weather improves as the crop grows, so *an early check can be repaired* and is relatively unimportant. There are also differences between the two crops in the ratio of leaf-weight to stem-weight. In Egypt the original ratio at germination (leaf weight=180 per cent. of stem weight) persists; in the Sudan it decreases until at ten weeks the leaf- and stem-weight are roughly equal. In other words, the Egyptian plant is much more "leggy." With regard to flower-bud formation, flowering, and boll-opening, the Gezira is four weeks ahead of Egypt. The Gezira has thus a month's gain in earliness over Egypt, and since it has also a growing season longer by two months the better climatic conditions go to balance the poorer soil.

Another important result established by studies of cotton in the Gezira is the high correlation between rains in July to mid-August (*i.e.*, *immediately before* sowing), on the yield of the crop. A relationship, from general observation, had been put forward in 1941, and Crowther later, by a statistical analysis of the yields and rainfall, established a significant positive correlation between these, and cal-

culated that 100 mm. of extra rainfall *before sowing* would increase the yield by about 1 kantar per feddan (1 kantar=312 lb., 1 feddan= 1·038 acres). Heavy rainfall *earlier*, however, tends to reduce the yield.

Reference must also be made to F. Crowther's studies of the cotton rotation experiments in the Gezira. It was shown in 1941[5] that frequent fallows are a first necessity in any rotation for cotton in this area. It was demonstrated that in a three-year rotation cotton should not be sown more than once, and that the inclusion of dura (*Sorghum vulgare*) in the rotation always reduces the yield of cotton. Later there was a remarkable further development, for it was demonstrated[6] that *weeding* the fallow during the rains had an almost spectacular result; for double-fallow hoeing gives almost twice the yield to be obtained from cotton following dura and an unhoed fallow, a rotation which was part of the normal practice in the Gezira. In addition, the bad effect of dura on the cotton crop can be avoided by fallow hoeing the land between the two crops. It may be contended that this work is agronomy rather than plant physiology. The dividing line, however, between two such fields must necessarily be vague, since most agricultural operations affect the plant's physiological response. In whatever category the results are placed they indicate very clearly what can be accomplished by a worker trained in the modern discipline of crop physiology.*

Cultivation of Tea in Ceylon

Another example of the direct aid which plant physiology can give to the improvement of methods of cultivation is the work on the pruning of the tea plant carried out by F. R. Tubbs,[7] the plant physiologist on the staff of the Tea Research Institute of Ceylon.

The growth of the tea bush is controlled by infrequent but relatively severe prunings, combined with a large number of "pluckings" which are in effect mild prunings; the plant is also subjected to "tipping." Severe pruning of the cultivated tea is necessary to prevent the bush taking on its normal pyramidal shape, and to provide instead a low-spreading frame which will give the large "plucking-table" required for economical harvesting. The effects of different types of pruning and of tipping and plucking, and of their frequency, all play a part in controlling the growth of the bush and, accordingly, its yield. The young leafy shoot (the "flush") which is plucked is itself some drain on the plant's economy; for of the amount of material lost by its removal the shoot has itself manufactured only about half, the rest being drawn from the plant's reserves. The process of pruning,

* The fallow hoeing increases both the nitrogen and the moisture content of the soil and this raises directly a plant-physiological question, that of root-penetration in such soils.

though much less frequent, necessarily entails a heavy loss of substance.

By an elaborate series of field experiments laid out in modern form and continued over a number of years, a study was made of the effects on the bush of different methods of pruning, of the length of the " pruning cycle," of tipping and plucking, and also of the effect of pruning on the root system. From these investigations most valuable results accrued. The type of pruning was found not only to influence yield, as was to be expected, but also to affect the character of the tea as determined by the tea-taster. With regard to methods of plucking it was found that " short " plucking might give an increase of 100 lb. an acre. But an even more striking result was the relationship which was established between the elevation at which the tea is grown and the type of pruning to be employed if the health of the bush is to be retained. To the plant physiologist it is, of course, obvious that pruning and plucking must of necessity reduce the plant's reserves; consequently, it was not surprising that the investigations showed the need to relate the severity of pruning to the level of the reserves, which are found mainly in the root, very little being stored in the stem.

In relation to the level of reserves it had previously been known that heavy damage or death from " die-back " was associated with absence of reserves in the root. There was further the very significant fact that these diseased conditions occurred generally *after pruning and chiefly at low elevations.* These earlier data fell into place as a result of the physiological investigations later undertaken; for when the root reserves were determined* in plants growing at different heights from 100 ft. to 6,500 ft. above sea level, it was found that there was a linear relationship between the percentage reserves in the root and the elevation.† The results obtained are given in Table I.

TABLE I

Elevation (ft.)	0	500	1,000	1,500	2,000	3,000	4,000	5,000	6,000	6,500
Reserves (per cent.)	11·2	12·2	13·2	14·2	15·2	17·2	19·2	20·2	23·2	24·2

It is thus evident the root reserves are very different in bushes growing at different levels. On this basis the frequency of " die-back " damage after the pruning of bushes growing at low levels becomes understandable; and it was possible to a considerable extent *to rationalize the process of pruning*, and choose the method of pruning according to the level of the reserve-store. At elevations above

* Estimated as glucose after hydrolysis.

† The simple relation was established of $y = 11{\cdot}17 - 0{\cdot}2x$, where y = the percentage of reserves and x = 100 ft. of height above sea level.

3,000 ft. the reserves are sufficient to allow of recovery after severe pruning. At lower levels it is imperative to leave a sufficient area of foliage upon the bush if "die-back" and death after pruning are to be kept down. The recommendation resulting from the physiological studies is that below 1,500 ft. the amount of foliage left should not be less than 250 developed leaves per bush. A number of "lung" branches (*i.e.*, branches bearing foliage) sufficient to give this number of leaves must therefore be allowed to remain on the plant at the time of pruning. Table II illustrates the relationship of foliage and root reserves.

TABLE II

No. of "lung" branches ..	0	3	6
No. of leaves per bush	3	203	328
Reserves (per cent.)	10·6	13·4	13·16

The close relationship between the leaves present on the bush and the mean dry weight of "flush" (actively growing shoots) harvested from "clean-pruned" bushes during five successive periods, each of 63 days, is shown in Table III.

TABLE III

Period	"*Flush*" *harvested*	*Leaves present*
1	15·6	88·5
2	24·0	164·2
3	29·9	229·1
4	30·1	202·8
5	34·5	260·3

The correlation between flush and number of leaves was 0·99 for these five periods.

By these physiological investigations the practice of pruning has been largely put on a scientific basis, with the result of the establishment of the type of pruning required to allow of tea being grown at low elevations.

COMPARATIVE STUDIES OF FIELD CROPS

Reference has already been made to the comparison made by F. Crowther between the physiological behaviour of cotton grown respectively in the Sudan Gezira and the Nile Delta. Watson[8] using the crop sampling method has recently made comparative physiological studies of a variety of crops grown at the Rothamsted Experimental Station, studying especially the leaf-area and the leaf efficiency of the different crops. By simple measurements at regular intervals of total dry weight and of leaf-area, one can determine the rate of increase of dry matter per unit area of leaf surface, thus obtaining a measure of the *plant's efficiency* as a producer of material; for the increase of dry matter gives a balance between the material manufactured by the leaf and that lost by respiration. The crop analysis also shows whether

the factors studied affect leaf number or leaf size or both. Only one important result obtained in these studies can be mentioned. It is obvious that a plant is *most efficient as a producer of dry matter if its maximum leaf-area is reached at a time of year when that leaf surface can operate most effectively.* Under Rothamsted conditions it was found that barley (gaining 3·4 cwt. per acre, weekly) was the most efficient since its maximum leaf-area coincided with the midsummer peak of leaf assimilation. Potatoes (2·9 cwt.) and sugar beet (2·9 cwt.) were much less efficient, for they produced their maximum leaf-area much later than the summer, *i.e.*, in September or later according to the date of sowing.

A result such as the above is clearly a pointer for the plant breeder, at least in these latitudes. For vigorous growth the leaf-area should not only be large but also reach its maximum at the time when its effectiveness can be greatest.

Length of Day and the Physiology of Onions

In all matters of importation of plants for growth in new localities the physiological reaction of the plant to the duration of daylight (the so-called length-of-day effect) must be considered. Onion varieties imported from California during the war were found of little value in this country; this was to be expected from the work of Maginder and Allard.[9] Onions also provide one of the most recent contributions of plant physiology to crop research. O. V. S. Heath *et al.*[10] by means of field experiments have studied the effects on bolting, on yield, and on time of ripening of (*a*) variety, (*b*) size of " set," (*c*) date of planting, (*d*) nitrogen manuring, and (*e*) winter storage at high and low temperatures. The experiments were of factorial design so that interaction as well as the average effect of the single factors could be observed. Only one result can be referred to. The use of large " sets " increases yield, but a disadvantage of the practice is that such sets show a higher percentage of bolting, except with the non-bolting varieties. This difficulty can, however, be surmounted by *physiological pre-treatment, i.e.*, high temperature storage (14 weeks at 20-24°C.) of the sets before planting. The treatment controls bolting, and has the further advantage of delaying ripening, and so extending the growth period with a concomitant increase of yield. The " ripening-delay " effect applies also to the non-bolting forms so the pre-treatment increases the yield of both classes of varieties.

Weed Control in Linseed and Flax

The present need for a greatly expanded acreage of linseed has made urgent the control by herbicides of the weeds of this crop. Recent work by G. E. Blackman[11] has shown how delicate is the physiological

balance in the responses of linseed and flax to these substances, and particularly to the toxic growth-promoting substances which are the latest and most potent weed destroyers, being effective in quantities as small as a single pound per acre. With *linseed* the growth substance M.C.P.A. (2-methyl-4 chlorophenoxyacetic acid) can be used at a concentration of 0·2 per cent. without risk of damage to the crop; with D.C.P.A. (2: dichlorophenoxyacetic acid) on the other hand, the concentration must not exceed 0·1 per cent., using in both cases a standard rate of spray of 100 gallons per acre (*i.e.*, 1 lb. of substance per acre). It is, however, essential that the spray be given at the right time, that is in the *resistant* period when the plants are *between* 3-4 *ins. and* 12 *ins. high*. Spraying either earlier or later than this injures the crop.

For weed control in *flax* on the other hand, the conditions for spraying are different and even more stringent. The plants must be *between* 4 *and* 10 *ins. high* and the concentration of M.C.P.A. must be reduced to 0·075 per cent. If a concentration suitable for linseed is applied there is no reduction of seed or straw, but the yield on scutching may be reduced by as much as 48 per cent. *A most interesting example of selective action on the plant is thus revealed.* The weed-killing agent leaves unaltered the general growth of the flax stem, while exerting a specific physiological effect on the differentiation of the fibres.

When crop research is required to develop a technique to meet such a delicate balance in plant processes it seems hardly necessary to stress the need for the physiological outlook. It is certain that with the expansion of the use of substances of such high physiological activity many more complex physiological phenomena of this type will be encountered.

Fundamental Research

A word may be said on the place of fundamental or long-range research. It is a commonplace that any investigation in applied science almost inevitably brings to notice the need for further fundamental knowledge relevant to the work in hand. Whether the lacunæ thus revealed shall be brought to the notice of workers in institutions the main purpose of which is the advancement of pure science, or whether the research team shall themselves attempt to fill the gap, depends on a variety of circumstances, such as the urgency and nature of the problem and the equipment available to the research team. If the long-range work is undertaken by the crop research workers it is important that the fundamental work *shall not be allowed to thrust the applied work into the background.*

The examples which have been given indicate something of the part which plant physiology has played and can play in crop research. The need for the viewpoint of the physiologist is all the greater in

face of the difficulty of achieving biological generalizations. Almost every plant is " a law unto itself "; and whether we wish to gas-store apples or kill weeds in a crop, the response of each species, and even each variety, calls for separate study.

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INSECTICIDES AND THEIR APPLICATION 1945-47

BY

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DURING this period considerable progress has been made in the search for new insecticides and new formulations, and in the improvement of methods of application. There has been less progress in the actual control achieved and this may have been caused by the world-wide post-war disruption, by the shortage of scientists of the type needed for pioneer development in the field, and by administrative difficulties preventing proper exploitation of technical knowledge.

One measure of the lag of practice behind laboratory work is the fall in price of insecticides, old and new—*e.g.*, pyrethrum and D.D.T.—although this has been brought about partly by the war-time accumulation of stocks and tremendous expansion of manufacturing capacity.

The pressing need to grow more food, and to transport it and store it in good condition, will surely call for wider use of insecticides, and this, in turn, will stimulate research on insecticides and their application. Large-scale agricultural development in the tropics will be accompanied by the growth of transport and secondary industries, and will necessitate control of insect vectors of diseases of man and animals as well as plants. To secure this control, insecticides will be required also. The mechanization of agriculture is proceeding fast in many countries of the world, and is being accompanied increasingly by mechanized application of insecticides. These changes will be most striking in large areas, such as those now being developed in Africa, which have hitherto been neglected, and where agriculture has been primitive. Farming on the large scale calls particularly for the use of insecticides and provides conditions that favour mechanized application. For example, some of the newer insecticides have given most successful control of pests of cotton. Wettable dusts, in particular, are promising, and there is urgent need of big field trials to decide the best formulation amd method of application for particular conditions. The question of costs necessarily arises, but, as already pointed out, the price of insecticidal materials is falling, and if the trials show that an increased yield can be obtained consistently by the use of insecticides, then this use may well be justified even with such a crop as cotton, with which the margin of profit to the actual grower is small. It may prove that the successful extension of areas

under cotton will depend partly on the judicious use of insecticides, and that in some regions, such as the Central Province in Tanganyika, a government subsidy should be provided to ensure their application because of the necessity in that region of a cash crop for which cotton is especially suitable.

Whilst big developments are the most striking, improvements in formulation and equipment which assist the small grower have a large effect in sum. What is most required is elimination of the many designs of equipment which have no outstanding merit, and the standardization of the minimum number required to do the jobs that the small grower has to do. Such standard equipment should be as efficient as possible, but above all it should be robust, and spares for parts liable to wear and damage should be readily available and easily fitted. Some progress in this direction has been made, and when the merits of the new equipment are appreciated, demand will lead to further progress.

The new insecticides and repellents which have been coming into use during the last 2-3 years are mostly synthetic chemicals. The older insecticides of vegetable origin, pyrethrum, nicotine, and rotenone, have still a wide field of application, but no new insecticide of this class which has proved to be of major importance has been discovered. Indeed it has sometimes been suggested that the pyrethrins themselves may be obtained synthetically instead of by extraction from the plant, but although parts of the molecules have been synthesized, the synthesis of the complete active principles, at an economic price, would seem to be some way off. One of the advantages of pyrethrum insecticides is their interaction with a considerable number of compounds to produce an insecticide more toxic than either component separately. These compounds are termed *synergists*. The manufacture of new chemical synergists for the pyrethrins still continues steadily, and in some formulations the synthetic constitutes the larger part. The pyrethrins remain outstanding for the degree of synergism that they show and the number of substances with which they show it. They remain outstanding also for their absence of toxicity to man and animals and plants. Certain of the new synthetics are better, in this respect, than others, but they are, in general, less efficacious.

In addition to the discovery or synthesis of these new substances advances have been made in testing, formulation, stabilization, application, etc. Many of the advances will be found to bear on more than one insecticide, but inasmuch as each advance has been developed with one insecticide or type of insecticide, and will require some modification in the extension of it to other types, it is convenient to relate each insecticide or class to the advances in technique, etc., associated with it.

Pyrethrum.—The greatest drawback to pyrethrum insecticides has been their liability to lose their toxicity when spread out in thin films,

particularly in the open air. This is due partly to oxidation and partly to other chemical changes. Oxidation of preparations in bulk is prevented by the inclusion of anti-oxidants, but these are not effective in very thin films. Both types of action proceed rapidly only under irradiation by ultra-violet light, light of wave length just beyond the visible spectrum sufficing. Attempts to improve stability by absorbing these radiations, either by the addition of special dyes or by other means, appear promising. Claims have also been made for the stabilizing action of trialkyl phenols such as 2,4,6-tri-tert-butyl phenol.

Established synergists such as isobutylundecylenamide, sesamin and sesame oil concentrates, are still being used satisfactorily, but new ones are now being incorporated in pyrethrum insecticides for which high claims are made. One of these, Octacide 246, is a tri-cyclic alkyl pyrolidone, others are methylene-dioxyphenyl cyclohexenones. These compounds are stated to be harmless to man, toxic to insects by themselves, and strongly synergistic with the pyrethrins. Two of the better known of these synergists consist largely of piperonyl cyclo-hexanone and its derivatives and piperonyl butoxide. It seems that all the synergists so far studied act, not by altering the mode of action of the pyrethrins or by facilitating their penetration through the cuticle, but by conferring on a definite weight of pyrethrins an increased toxicity. This effect frequently increases with addition of the synergist until the synergist and the pyrethrins are present in molecular proportions, when the pyrethrins are about three times as toxic as when the synergist is absent. This is true whether toxicity is measured by action of a direct spray on flying or crawling insects or by the residual effect of a sprayed surface on insects which subsequently come into contact with it. A fresh claim is made for the most recently discovered synergists, namely the prolongation of the period over which a sprayed surface remains insecticidal. In fact, compounds such as piperonyl butoxide appear to be stabilizers as well as synergists. If this is substantiated it will be of great importance if only because insecticides of this type are harmless to man and animals and could be used with complete safety on animals, on plant parts which are to be used as food or fodder, as dusts to be mixed with grain and other dried foods, and in the impregnation of bags for holding food of types which absorb the new synthetics.

The flight stimulating properties of pyrethrum are sometimes made use of to secure the pick up of a lethal dose of other insecticides by house flies. The rapidity of action peculiar to it is also valuable to secure knock down of flies and mosquitoes, and the quick paralysis of lice which may otherwise continue to spread disease after receiving a lethal dose of other slow-acting insecticides. The synergists are valuable also in these preparations.

The useful life of pyrethrum films is largely governed by the nature of

the surface on which they are formed. Films on porous substances quickly become ineffective, whilst those on hard substances, which do not absorb the oil carrier, will retain their insecticidal value for months. To form a lasting film on absorbent surfaces the surface may be treated first with size or gelatin. Alternatively, it may be sprayed directly with certain types of pyrethrins-containing emulsions which break and allow the water to be absorbed whilst the oil remains on the outer surface and forms an insecticidal coating, which remains toxic over a considerable period.

Chemical determination of the pyrethrins has always presented some difficulty. Divergent results are often obtained by different analysts using similar methods, and by the same analyst using different methods. It is confidently expected that international co-operative work now in progress will overcome this difficulty, and will contribute to satisfactory marketing.

Pyrethrum continues to be used in many formulations for the control of house-flies. Amongst these formulations are the aerosols, which contain a solvent-expellent which is a liquid under its own vapour pressure whilst it is in the sealed container, but which evaporates when it is expelled through a jet into the air of the room, and leaves the non-volatile part in the form of a fine insecticidal mist. New developments include the substitution of the original expellent, Freon 12, by one of lower vapour pressure, thus permitting the use of a cheaper container, the addition of anti-corrosive agents, such as propylene oxide or salicyl-amino-guanidine, and new methods of removing the waxes from the pyrethrum extract.

Rotenone and Nicotine.—These two insecticides continue to be used in controlling agricultural and horticultural pests. The safety with which rotenone may be used, and the volatility of nicotine, which allows of its being employed as a fumigant for row crops—given a mobile vaporizer and " tent "—are perhaps their outstanding features.

D.D.T.—The chemical stability and low vapour pressure of this insecticide make it particularly suitable for applying to surfaces to render them insecticidal. Observations of the long-continued toxicity of heavy deposits has created an impression that the toxicity is practically permanent, and that spraying of D.D.T. to obtain a residual effect is entirely different from spraying pyrethrum extracts. This impression needs qualifying. In the open air the longest period of efficacy on vegetation or on water is of the order of a few weeks, whilst on tropical vegetation it is very much shorter, and about half the D.D.T. applied disappears practically at once. In air, irradiation with ultra-violet light hastens oxidation, whilst, in the absence of air, it promotes other reactions, the nature of which varies with the solvent. In some circumstances D.D.T. loses hydrogen chloride and becomes ineffective. This

reaction is catalysed by several inorganic substances, of which the one most likely to be of practical importance is ferric iron. Fortunately salicylic aminoguanidine and propylene oxide, which may usefully be added to aerosol formulations to reduce corrosion, also inhibit dehydrochlorination. D.D.T. should not be used in an alkali medium and it may, therefore, be incompatible with free nicotine. The loss of D.D.T. in foliage, etc., can be reduced by modifying the formulation of emulsions as, for example, by the addition of glyceryl mono-oleate or aluminium naphthenate. It is advisable to keep the proportion of emulsifier fairly low to avoid undue "run off." Cationic emulsifying agents are to be avoided as they promote phytocidal damage as do certain solvents such as paraffin. In choosing a solvent for an emulsion concentrate the solubility of D.D.T. at 0° should be not less than 25 gm. per 100 ml. There are several substances available—*e.g.*, toluene, xylene, alkylated naphthalenes, and certain vegetable oils such as eucalyptus oil. There is some indication that the more volatile solvents leave deposits which retain their toxicity better than those from less volatile solvents, but solvents with low flash points should not be used.

Sprayed surfaces which are protected from the weather and from sunlight remain insecticidal much longer, but there is a big variation with the nature of the surface. On hard substances, like glass and masonite, there is still a good toxic deposit eighteen months after the original application, whilst on surfaces of plain cement, fresh whitewashed cement, old whitewashed cement, and fresh painted pine, toxicity disappears in from eight to twelve months. Certain surfaces require heavier exposits initially and the behaviour of the residue on some soft surfaces can be unexpected; for example, on planed pine and on "tentest," a fairly porous material, toxicity is very well maintained. It may be that some anomalies are connected with the tendency of D.D.T. to form glass-like supersaturated solutions, and the ease with which the crystals, which are the more toxic form, separate from them with different substrates. The retention of the crystals may also vary with the substrate. Recovery of D.D.T. from treated boards by planing off the top 0·001 in. and the top 0·006 in. varied with the nature of the wood and its water content and the volatility of the solvent, whether in a straight solution or in an emulsion. The recovery was better with wet wood and with a volatile solvent. The physical properties of the wood could not be correlated with the recovery.

Other methods of obtaining a residual effect with D.D.T. must be mentioned. Several types of paint containing the insecticide have been tried experimentally. Their efficacy is related to the amount of D.D.T. which crystallizes after application, and this, in turn, is related to the degree of supersaturation of the solvent before application. A wall paper containing 5 per cent. D.D.T. has been produced and is stated to

remain effective against household insects for at least a year, and to retain its efficacy after cleaning. Moth proofing by incorporating 0·5 per cent. by weight of the cloth during dry cleaning is claimed, a special addition to the plant avoids loss of insecticide and solvent. An important use is for impregnating sacks and other food containers. Further work is required, but it is established that considerable protection is afforded by a deposit of from 1 to 5 per cent. on sacks, the lower deposit being effective with thick finely woven material, and the higher with coarser fibres and more open weaves, which offer less mechanical obstruction to the penetration of insects. Impregnated containers serve to protect clean food within them from attack from outside, or to prevent the spread of infestation to other packages if the food within is infested when packed. Some of the D.D.T. is liable to be transferred to the food, and if this is of an oily or fatty nature the amounts transferred may be dangerous.

The toxicity of D.D.T. to man and warm-blooded animals now appears to be low enough to permit its use in stores, if this is carefully regulated. D.D.T. dusts, diluted with inert material, can be mixed with certain dry food, such as grain, if the mixing is uniform and the grain is properly cleaned before grinding. D.D.T. should not be sprayed on parts of plants intended for food or fodder. Wettable dusts are the least toxic form, if applied to the skin. If taken internally all forms are of the same order of toxicity.

The toxicity of D.D.T. to certain insects appears to be quite low, and the range of doses for different species wider than at first thought. It is not very effective against ticks on cattle, particularly those which are engorged, although it offers considerable protection from re-infestation. The larval stages of many species of fly are resistant to it. Although the outstanding success of D.D.T. in the late war was in the control of lice, new synthetics are now available which are more toxic to these insects. D.D.T. continues to give promising results in the control of pests of cotton and maize, and some of the pests of forest and ornamental trees. It appears likely to have a permanent place in orchard spraying, and may partly eliminate the necessity for the regular application of tar oil winter washes. It is particularly useful in controlling capsid eggs, apple-blossom weevil, and the caterpillars of winter moth and many other leaf eaters. It gives good control of codling moth without leaving dangerous deposits. In general, D.D.T. is not very useful against aphids, but an exception is the apple aphis. It is effective against many pests of vegetables including some which carry disease, such as green fly on potatoes.

The effective toxicity of D.D.T. varies with the insect and with the formulation. It is difficult to generalize widely, but some information of limited scope is available.

The residual surface effect is better when the D.D.T. has crystallized out from the supersaturated solutions which are generally left after the more volatile fractions of the solvent have evaporated. This crystallization can be induced by very slight disturbance of the surface such as stroking with a brush. It is probable that dust will sometimes "seed" out the crystals, and even insects crawling over a surface produce the same effect and "activate" it for those that come after.

The habits of aquatic insects divide them roughly into two types as regards the effective formulation of D.D.T. insecticides, those insects which live on the surface or come to the surface frequently for feeding or breathing, and those which remain, for the most part, beneath the surface. The former are effectively controlled by a surface film containing D.D.T. either as a continuous film of oil or a film of minute oil droplets resulting from the breaking and spreading of an emulsion which contains insufficient emulsifier to allow it to mix with the bulk of the water. The latter are effectively controlled only by an emulsion which mixes with the water, or by solid absorbent "bricks" or "pellets" which are submerged in the water and liberate the insecticide gradually.

The particle size of solid preparations, dusts, wettable powders, and suspensions is of importance, but more than one effect may be involved. Crystals of D.D.T. have been prepared of a wide range of size and shape, but all of the same fundamental habit. Some tests indicate that with direct spraying and with dipping, the toxicity is proportional to the amount retained which, in turn, varies directly with the particle size. Under other conditions, however, it is probable that other factors come into play, and there is no doubt that certain preparations containing very finely divided D.D.T. are highly effective. In preparing dusts for mixing with grain, etc., as well as dusts for certain purposes in the field, the required degree of dilution with the inert material is such that a fine state of subdivision of the D.D.T. is desirable.

Experiments with rotenone have shown that there is an optimum size range for the diluent and that extremely fine dusts enclose the particles of insecticide and preclude adequate contact with the insects. It is probable that this applies, in varying degrees, to all insecticidal dusts.

Benzene hexachloride (Hexachlorocyclohexane, B.H.C. Gammexane).—The active ingredient of preparations of this insecticide is the gamma isomer. Since 1945 it has come into much wider use and appears to have become as important a material as D.D.T. Gammexane is a stable crystalline substance similar in these respects to D.D.T. but decidedly more volatile. This volatility has the advantage of conferring on it some degree of fumigant action, but the disadvantage of rendering the residual surface effect somewhat less lasting. Where, however, the loss of surface toxicity with time is due mainly to absorption or catalysed decomposi-

tion, loss through evaporation may be of minor importance. It is not unlikely, too, that the volatility of the gamma isomer in commercial sprays is very much reduced by the presence of other ingredients and that experiments undertaken with the pure gamma isomer in solvents of high or moderate volatility are misleading. Like D.D.T., gammexane is both a stomach poison and a contact insecticide which acts on the insect nerves. In general, its action is more rapid than that of D.D.T. though much less rapid than that of pyrethrum. It has been used successfully in the control of most insects for which D.D.T. has been used, and in some cases much greater success has been achieved. Notable amongst these are the following: the control of larvæ of house flies, blow flies and certain cattle flies, against which D.D.T. is of little value; the control of lice and ticks on cattle, killing eggs of the lice, as well as motile forms, and both flat and engorged ticks, at low rates of application; the control of human lice, and the protection against chigger mites* and lone star ticks when applied to cloth; the control of hide beetles (dermestid larvæ) in dried wool skins. Bed bugs and cockroaches are considerably more susceptible to gammexane than to D.D.T. One of the chief drawbacks of gammexane for many purposes has been its odour. In England it is now being made in several grades which have much less odour than early samples, and some of which, as a residual spray, are practically odourless. It is generally considered that the toxicity of gammexane to warm-blooded animals is of the same order as that of D.D.T. and similar considerations regarding safety in application and dangerous residues apply. For these and other reasons the use of a wettable powder is much to be recommended for many purposes, particularly for application to cattle and other animals.

The thermal stability of gammexane and of D.D.T. has suggested the use of smokes which are generated by burning paper or cord impregnated with suitable oxidants and the insecticide, or by igniting a combustible cartridge containing similar ingredients. The insecticide is vaporized, and the vapour, which is carried away by convection, is immediately condensed in the air as a finely particulate cloud. This method of application has certain advantages. It is fairly effective against flying insects and is convenient in buildings, parts of which cannot be reached by direct spraying. The particles do not diffuse like a gas, but, as with aerosols generated from volatilizing solvents, move either under gravity or by air convection currents. Thus the particles are eventually deposited mainly on the upper sides of horizontal surfaces, and partly in cracks or hidden spaces through which there happens to be a flow of air. In still air it is surprising what coarsely woven material will hinder the flow of air and reduce deposition. Certain types of cartridge will function under

* These chigger mites are members of the family Trombidiidae. They are not related to the jigger or burrowing flea of Tropical America and Africa.

water, and may be convenient for controlling mosquito larvæ. There appears always to be some loss of insecticide by decomposition.

Chlordane (Velsicol 1068, Octa-Klor).—Technical chlordane is stated to consist of 60 per cent. 1,2,4,5,6,7 8, 8=octachloro-4, 7-methano-8a,4, 7,7a-tetrahydroindane and 40 per cent. related products of the same order of toxicity. It is a viscous liquid and possesses the advantage of being completely soluble in kerosene as well as in the other common organic solvents. It is not soluble in water. It is chemically stable except in alkaline media. It is a stomach and contact poison and is claimed to be a highly effective fumigant, at least against the flour beetle and against wire-worms in the soil. In general, as a contact insecticide, it appears to be slightly superior in laboratory trials to D.D.T. Its residual effect is generally of shorter duration. It appears to be promising for the control of lice on cattle and has been used successfully against cockroaches and Pharaoh's ant. It is superior to D.D.T. for the control of chigger mites and in the form of a wettable powder for the control of ticks on cattle. Chlordane appears not to be phytocidal and can be used even on tomatoes and cucurbits. It is ineffective against codling moth, aphids and certain other pests. Chlordane is about as toxic to man as D.D.T.

Chlorinated Camphene (Toxaphene).—This is a slow-acting insecticide of the D.D.T. class. Data are scanty, but it appears to be inferior to D.D.T. against most insects. It may be more effective against the lone star tick, the winter horse tick and lice on cattle. The toxicology of this insecticide has not yet been thoroughly investigated.

Combinations of Insecticides.—There is still a big unexplored field, but several promising combinations have been tried. One such is the addition to D.D.T. of Dynone (the dicyclohexylamine salt of dinitro-ortho-cyclohexylphenol). The object is to control the red spider on apples, which builds up badly if D.D.T. is used to control winter moth, capsid, codling moth, etc. Dynone alone is stated to be relatively non-toxic to predators such as ladybirds and Anthocorid bugs. It would seem likely that gammexane might usefully be combined with D.D.T. where the initial toxicity of the former might be reinforced by the long-continued protection afforded by the latter, for example, in dealing with ticks and various insects affecting cattle. Numerous successful combinations of insecticides and fungicides are in use. Other combinations of slow and quick acting insecticides have been previously mentioned.

Methods of Application.—There has been no outstanding advance which has been fully developed so that it is ready for routine adoption. The thermal or fog generators have not, as yet, been applied successfully to agricultural pest control. There has been improvement in detail in design of equipment for orchard spraying, particularly in the proper spacing of nozzles and the proportioning of the various units. Special

machines have been constructed for special purposes—*e.g.*, multi-nozzle sprayers and dusters with high ground clearance for tall crops up to 6 ft. high. The use of drag sheets to confine dusts to the plants is a feature of some of these machines. Wetting the under surface of leaves is still a difficulty with row crops. If spacing permits, a good deal can be done with a multiple nozzle broom with nozzles at different levels and set at different angles. It is claimed that this wetting can be achieved also by spraying from a helicopter, advantage being taken of the powerful air currents available to "bounce" the spray back on to the lower surfaces of the leaves. Other advantages claimed for this method of application are accurate placing of the insecticide and applicability to tangled plants. With new designs of helicopter the acreage treated per day should be much increased and the applicability of the method extended.

Received March, 1948.

SOME STUDIES ON CULTIVATION PRACTICES, FOOD CROPS AND THE MAINTENANCE OF FERTILITY AT THE COTTON STATION, NYASALAND*

BY

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THE cotton industry in Nyasaland is one of African peasant growers, and the work at the Cotton Experiment Station is primarily concerned with cotton problems. But cotton is not grown as a mono-culture, and the chief native food crops of the area are included in the rotation. There is also the universal problem, especially important in Africa, of maintaining and improving soil fertility. This article is not directly concerned with cotton problems, and gives a summary of general investigations that have been undertaken since the Cotton Station was opened in 1930.

SITUATION, ECOLOGY AND SOILS

The Cotton Station is situated at Chitala, some 14 miles inland from Domira Bay, on the plain bordering Lake Nyasa. It lies on about latitude 13° S. and at an elevation estimated at 1,985 feet above sea level. Its lands are close to the main fault system on the western side of the Rift Valley, and immediately to the west of them are the foot-hills, and farther back the main escarpment which forms the dominant feature of the landscape.

The soils of the Station can be roughly classified into two series: one a reddish-brown soil on areas with good natural drainage, the other a black soil which occurs where drainage is not so good. An extensive study has been made at Rothamsted of large samples from the two series, and it appears that the general mechanical composition of the two soils is similar, and that the black coloration is due to some peculiar difference in the state of the iron compounds. The black soils show calcium accumulation in the form of nodular concretions which are lacking in the reddish-brown soils, the latter being somewhat more acid. The contrast between the two soils becomes more evident as one moves towards or away from the foot-hills, the red soils predominating and becoming redder towards the hills, and the black soils predominating on lower levels nearer to the lake.

* From the *East African Agricultural Journal*, October, 1947.

The average rainfall for the past seventeen years is 33 inches, nearly the whole of which falls in the four months from December to March. Within this period distribution is normally good, and heavy falls of over 3 inches per day occur only once or twice each season. Variation in the total rainfall has not been large, ranging from 27 to 36 inches, with the exception of one year when the total reached 46 inches. The distribution is important in determining high or low yields, but there is no known record of shortage of rain causing a complete crop failure. The mean maximum temperature in December at the beginning of the planting season is about 90° F., falling to 85° F. in May, when the rains are over. During the same period the mean minima fall from 70° F. to 60° F. Extremes recorded to date are 101° F. maximum in November and 42° F. minimum in July.

The Station lands have a very mild slope and it has been possible to make all the fields rectangular and standardize their dimensions, which is a great advantage in experimental work. Erosion has been satisfactorily controlled by ridge cultivation and by a few shallow drains to prevent surface wash. In fact, the problem on quite a large area of the heavier lands is to provide surface drainage. In a few places the general slope of about 1 in 150 is exceeded and contour bunds have been made and contour ridge planting has been adopted. The first fields opened still give as good yields as they did seventeen years ago, which may be regarded as proof of the general efficacy of these mild anti-erosion measures for this particular site.

The lake shore plain lies in a tsetse-fly belt and no animal-drawn cultivation has been possible except for a brief and abortive experiment in keeping work oxen free from trypanosomiasis by regular injections. No tractor-drawn implements have yet been used and the whole of the cultivation to date has been by hand, except for a little ploughing in the two years with the oxen. In fact, it may be said that the cultivation practices on the Station are no more than could be done by an energetic African peasant.

In the account which follows all results quoted are based on statistical experiments.

Cultivation Practices

The main experiment, begun in 1938-39, was a factorial one comparing ridge and flat cultivation, early and late preparation of fields, and three levels of digging. This experiment was carried out on a black soil field in good heart for four consecutive years through the normal rotation, and similarly for three years on a brown soil field which had been cultivated by Africans and was in a low state of fertility. Results are therefore available for seven occasions. The fields used formed part of the main Station rotational plan and were cropped in cotton, ground-

nuts, cotton and maize, in that order. There were also several later experiments concerned with digging only, and others on the frequency and timing of post-planting cultivations on cotton. Where ridge is mentioned in this account, a low ridge some 9 inches in height and 18 inches wide at the base is understood. Such a ridge settles during the season and is seldom more than 6 inches in height at the end of the rains.

Ridge and Flat Cultivation.—Three of the seven occasions were cotton crops, and in each case there was a significant increase in yield from the ridged plots. Out of two maize crops and two groundnut crops, one of each gave a higher yield from the ridged plots, once with maize there was a lower yield, and there was no difference on the other occasion with groundnuts. The yields of the ridged plots were 15 to 20 per cent. higher than the flat plots. The germination was higher on the ridged plots, but when the yields were corrected for final stand at harvest there was still a significant advantage for the ridged plots, showing that the advantage was not due to the greater number of plants. Six weeks after planting samples taken from the cotton crop showed that the ridged plots gave plants with a greater average weight and a higher moisture content, but no difference in height. Fourteen weeks after planting the plants from the ridged plots averaged 5 cm. taller than plants from the flat plots.

Ridge planting is justified if for no other reason than erosion control, and is doubly worth while as higher yields are obtained. It is suggested that the reason for the advantage is that nitrogen is not leached away so quickly from a ridge, as most of the rain will sink into the ground in the furrow. There is no direct evidence of this, but the higher moisture content of the young plants is suggestive.

Time of Preparation of Fields.—The local African cultivator usually delays the cleaning up and preparation of old fields until the very end of the dry season, and seldom completes the work until after the rains have begun. Although it is known that in this area the highest yields are obtained from planting as soon as possible after the rains begin, traditional African methods are often sound, and it was thought worth while to include this factor in the main cultivation experiment. The usual reason advanced for this habit of late preparation is that it entails less work; a field cleaned early may grow a second crop of weeds and tree-root suckers, and after rain has fallen the soil is easier to work, though few do more than burn weeds and trash in heaps. One possible reason for late clearing might be that bare fields are exposed to the very hot sun of the latter part of the dry season, and the humus content of the surface layers might be destroyed. The amount of ground cover on the "late" plots and the time of "early" preparation varied with the previous crop. On land emerging from rest there was dense cover,

and preparation of " early " plots (digging and ridging as needed for the different treatments) was completed by the first half of May. After a cotton crop the cover was of medium intensity and preparation was completed in July. After groundnuts there was practically no cover and preparation was completed in April. As maize was the last crop in each field, there was no trial of the effect of maize trash cover. The " late " plots were left undisturbed till the latest date by which the preparation could be completed before the rains, usually about the middle of November. In all cases the trash from the previous crop was burnt on the plots in random heaps and the ash incorporated with the soil.

The results from all experiments showed a small but regular increase in yield from the " early " plots. The increase was usually less than 10 per cent. and was most marked in the case of the maize crops following a cotton crop. There was no difference between the treatments in germination, weight or height of the cotton plants. It was concluded, again without direct evidence, that the slight advantage for " early " cleaning was due to greater accumulation of nitrates in the soil. The advantage was slight, and fields can be prepared at whatever time best suits the available labour, so long as preparation is completed before the rains start.

Digging.—In the main experiment there were three levels of digging: full digging over the whole area, strip digging about 10 inches wide along the planting row, and no digging at all. The digging with a native-type hoe averaged about 4 inches in depth. No yield differences were found until the last year of cultivation in each field, which in both cases was a maize crop. In the black soil field with a very fair mean yield of 2,500 lb. grain per acre the full digging gave a 15 per cent. increase over no digging. In the worn-out soil of the brown soil field with the very low average yield of 700 lb. per acre the increase was as much as 40 per cent. for the full digging. The strip digging gave an intermediate yield which was not significantly better than no digging.

There were five subsequent experiments concerned with digging. Cotton was planted with three treatments: no digging, normal digging to one hoe depth, and deep digging by trenching. The results were highly significant, no digging and normal digging giving increased yields of 19 per cent. and 13 per cent. over deep digging. The residual effect was tested the following year with maize, and the order of yields was the opposite of that with cotton. There was a progressive increase in yield from no digging, normal digging to deep digging, and the difference only just fell short of significance. Three more experiments with maize and one with groundnuts failed to show any differences.

Maize, therefore, was the only crop which showed any positive response to digging, but the size of the increase was not large enough

to pay for the cost of the work involved. From the native point of view increases in yield of the order found can be obtained with less effort by hoeing a slightly larger garden. It was concluded that digging of the land before planting was not necessary except for the first crop after a resting period; it must be done then to provide a good seed-bed. In all subsequent crops an adequate seed-bed is provided by making up the planting ridges. These conclusions would have to be modified if there were any real pressure on the land.

Early Cleaning of Cotton.—It does not take a profound knowledge of agriculture to realize that young cotton will not thrive when competing with a thick growth of weeds as big as, or bigger than, the cotton plants themselves. Nevertheless every year a large number of cotton gardens can be found with etiolated cotton plants drowned in a sea of weeds. This lack of attention is partly due to lack of interest in the cotton crop, and partly to preoccupation with food crops. But there are some Africans who maintain that the practice is advantageous, the cotton plant being made to grow tall and then quickly making fruiting branches when the grass is removed. The first contention is true, the second is not. Although the results of this experiment were a foregone conclusion, it was thought worth while to find out just how much the crop is decreased by late cleaning. The figures are so striking that they are quoted in full. One series of plots was cleaned before thinning, and another at the same time as thinning six weeks after planting. The plots were then divided and half had one and half two subsequent cleanings. The yields are expressed as percentages of the normal station practice.

	One cleaning after thinning.	*Two cleanings after thinning.*	*Mean.*
	Per cent.	*Per cent.*	*Per cent.*
Cleaned before thinning	84	100	92
Cleaned at thinning	26	40	33
Mean	55	70	—

A large percentage of the cotton gardens in the central areas of Nyasaland are not cleaned till thinning, and for many this is the only cultivation given. These figures show that the yield is only a quarter to a half of what it might be. The aggregate loss of crop, for want of a few days' work in the early stages of the plants' life, must be very large.

Food Crops

Maize Spacing.—Different varieties of maize have been tried over a number of years. All yellow varieties have been discarded, partly for low yield and partly because the labourers prefer to eat a white maize. Potchefstroom Pearl was grown for some years and was eventually

replaced with a selection from the local mixture grown in the vicinity of the Station. This is a hard white type and, though it yielded slightly less than Potchefstroom Pearl, has much better keeping qualities, and so is to be preferred. Four spacing experiments were made on this local selection and all led to the same general conclusions. A large number of spacings and numbers of plants per hole were tried, nearly all of them with a fixed inter-row distance of 3 feet. It was found that 2 and 3 feet inter-row spacing was better than 4 or 5 feet, no matter how many plants per hole were left. The 3 feet spacing was slightly better than 2 feet; two plants per hole gave the maximum yield for both 2 and 3 feet spacing, one plant per hole being a good deal worse and three plants slightly lower in yield. All maize on the Station is now planted 3 feet by 3 feet, which is rather wider than is often thought to give maximum yields; less labour per acre is required when planting at 3 feet than at 2 feet. Three seeds per hole are planted and no thinning or supplying is subsequently attempted. This is a labour-saving method which gives very satisfactory yields.

Groundnuts.—These are an important crop on the lake shore, as they are the only leguminous food crop which can be relied on to give a good yield. A large number of varieties have been tried, both bunch and runner types. There is some variation in yield, the best averaging rather more than 1,000 lb. of shelled nuts to the acre, and the worst about 800 lb. Apart from yield considerations it is important to choose a variety which is easy to harvest. The cost of growing a short ton, excluding all overhead charges, has been about £4 10s. Rather more than half of this total represents the cost of stripping the nuts from the plant and shelling with hand labour. With a small seeded runner type from Senegal this part of the cost is at least doubled. Two types have been retained for bulk plantings: an early bunch variety from Gambia and a semi-bunch variety, Mwitunde, imported from Tanganyika. The latter matures a little later and so labour requirements are more evenly spread out during the harvesting period. It is well known that for high yields and control of rosette disease it is essential to plant early and to space close together. The standard spacing adopted is to plant in two lines on either side of ridges spaced 3 feet apart; the inter-row distance on each side of the ridge is 1 foot. This spacing was tried against ridges 1 foot 6 inches apart with seed planted 1 foot apart on top of the ridge, giving the same plant population, but a more even spacing; and also with 1 foot 6 inch ridges with a double row 1 foot apart, giving double the standard plant density. There was no advantage in the closer ridges with the same population, but when the plant density was doubled there was an increase of 210 lb. per acre in a year with the exceptionally high average yield of 1,720 lb. shelled nuts to the acre. In a year of more normal yields it is unlikely that the difference

would be so great; and as the closer spacing requires about 40 lb. more seed to the acre and much more work in preparation, planting and harvesting, it is not justified. It is an advantage to sow two seeds per hole; if unshelled nuts are planted the germination is slightly delayed and is not quite so good, but the final yield is not affected. An experiment was tried with after-planting cultivation contrasting clean weeding with hand pulling of the largest weeds only, and really dirty cultivation with no weeding. The last treatment led to a decrease in yields, but there was no difference between the first two. The time of harvest is important with an early-maturing bunch variety which may sprout in the ground; the optimum time will depend to a certain extent on the season and the amount of moisture in the ground at harvest time. In one experiment with Gambia bunch the highest yield was obtained 105 days after planting; a week later the yield had dropped 6 per cent.; a week sooner or two weeks later it had fallen off by 12 per cent.; and three weeks later the loss was 15 per cent.

Another point of interest with groundnuts is that if two crops are planted in consecutive years, the yield of the second crop is reduced. This was first noticed on a European estate where large areas of groundnuts were being planted by tenant farmers. The first-year yields were good, but they fell off greatly the second year. This reduction of yield might have been due to a variety of causes, but no satisfactory explanation could be advanced until a number of the tenants said that they had always found a second crop to be poor; they had not mentioned this before planting because they assumed that Europeans knew better. About the same time a large reduction in the yield of groundnuts was found when one crop succeeded another after one intervening crop. The yields are taken from a rotation experiment and are given in the table below:

Rotation 1

1st year.—Cotton: 160 lb. lint.
2nd year.—Cotton: 226 lb. lint.
3rd year.—Maize.
4th year.—Groundnuts: 737 lb. nuts.

Rotation 2

1st year.—Cotton: 156 lb. lint.
2nd year.—Groundnuts: 776 lb. nuts.
3rd year.—Sorghum.
4th year.—Groundnuts: 374 lb. nuts.

It will be noticed that though in the first year the yield of cotton from the two sets of plots was identical, in the fourth the yield was reduced to half when groundnuts succeeded groundnuts. As no reason for this result could be found, a further experiment was laid down. In the final test year of this experiment groundnuts planted in two consecutive years were contrasted with groundnuts with one, two and three other

crops intervening. Different intervening crops were tested in the various treatments. The yields are given in the table below:

	Shelled nuts per acre lb.
Groundnuts following groundnuts	814
With one intervening crop	915
Mean of plots with two intervening crops	1,054
Mean of plots with three intervening crops	1,035
Significant difference	218

There was no difference between plots in the incidence of rosette or wilt disease, the amount of these diseases being negligible in all cases. It is not usual to plant groundnuts in consecutive years, as it has been found that maize gives an increased yield when following groundnuts. There should be at least two intervening years before the crop is planted again under the conditions which obtain at the Cotton Station.

Maintenance of Fertility

When the Cotton Station was first opened the rotation adopted was three years crop followed by two years rest under pigeon pea. Maize was always the last crop in the rotation and the pigeon pea was sown from four to six weeks after planting the maize. There were signs that this amount of rest would not maintain fertility indefinitely, but there were difficulties in the way of extending the period under pigeon pea. After the first year termites caused a big loss in the pigeon pea, and by the third year there were very few plants left. Also a wilt disease attacked the plants in patches, leaving a very poor stand. About that time Martin drew attention to the beneficial effect of grass on soil structure in Uganda. Elephant grass is not found on the main lake-shore plain, but only alongside the streams which run down from the hills during the rainy season. Every year the dried tops are burnt by bush fires, but the grass is not killed and planting material can always be obtained at the beginning of the wet season, and it has been found that these plantings grow well under field conditions.

A rotation experiment was planned in 1936 to test the suitability of using elephant grass to restore fertility. Various rotations were employed and the main comparisons were between no rest, one year's rest with pigeon pea, two years' rest under either pigeon pea or elephant grass, and three years' rest under elephant grass. Cotton was used in the first test year and maize for the second year. With the cotton crop the last three treatments were all equal and all better than one year or no rest. With the succeeding maize crop the results were rather different. Three years' rest was better than two years, and elephant grass was better than pigeon pea. It was therefore concluded that three years' rest under elephant grass was the minimum required

and further experiments are in progress to find out if four or five years give still better results.

It was thought that the lack of a leguminous crop in the resting period might slow up the restoration of fertility. If very worn-out land is abandoned to bush there is often a very heavy, almost dominant growth of Buffalo Bean (*Stizolobium* spp.) which becomes less common in later years. It has also been noticed that elephant grass planted on badly run-down soil grows less luxuriantly when planted alone than when mixed with pigeon pea. Accordingly an experiment was planned contrasting elephant grass alone and mixed with velvet bean. No difference was found in yield when cotton was planted subsequently. The point cannot be said to have been proved, as it was impossible to prevent the growth of buffalo bean among the elephant grass. The seeds of this plant must be capable of lying dormant for at least five years, as they grow up freely even after five years' clean cropping.

The planting and subsequent clearing of elephant grass involves an amount of labour which does not appeal to the African cultivator, so trials are going on to try to find a simpler method of resting the land. Various rest crops have been tried, including pigeon pea, allowed to degenerate into weeds, chance weeds, and the local long-term sorghum treated as a perennial. So far the results have been inconclusive, as no differences have been demonstrated.

Experiments have been made on different spacings and times of planting of the elephant grass, and results show that a wide range of both seem to give equally good results. Spacings have been tried from 3 feet by 3 feet up to 8 feet by 3 feet, and the resulting cover has always been excellent. This is a good deal wider than is reported as being necessary in Uganda to establish a good cover. The local variety of elephant grass is stoloniferous, and after the first year, when growth in Nyasaland appears to be slower than in Uganda, the spread is rapid and all other grasses are largely suppressed. The planting material used is main stems cut up into lengths of about 2 feet 6 inches, pieces bearing roots being preferred. These have been planted from January to early March, not far from the end of the rains, and in all cases a good stand has been obtained. For the time being the standard Station practice is to plant pigeon pea among the maize about the middle of January, when the maize is four to six weeks old. Elephant grass is planted later whenever labour is available, generally during a wet spell when hoeing is impossible. In the first year the elephant grass makes little growth and the pigeon pea gives a crop about September. During the second year the elephant grass makes rapid growth and a second crop can be taken from the pigeon pea if wanted. After that a good deal of the latter dies out with termite attack and is more or less swamped by the vigorous growth of the

elephant grass. The year before the land is to be cleared the grass is fired at the end of the dry season, and a fierce fire and a clean burn is the normal result. If this burning is omitted clearing is more troublesome the following year. A strong re-growth is made during the rains and this is cut down in March or April, burnt as soon as dry and the land then dug. Some roots continue to grow during the dry season and these are dug up at intervals. The grass can be burnt at the end of the dry season and the land immediately prepared for planting. But if this is done it is impossible to kill more than a percentage of the roots and a lot of labour is necessary in frequent cleanings of the subsequent crop.

Mixed Cropping

Mixed or inter-cropping has been tried at various times without success. The very short growing season necessitates the planting of all crops at the break of the rains to get maximum yields, and young plants growing together compete strongly for the available nitrogen.* The common haricot bean, which grows well among maize at higher elevations, does not thrive in the hotter climate of the lake shore. If groundnuts are planted among the maize the yield of the latter is not affected, but with a good growth of maize the yield from the groundnuts is so small as to be hardly worth the bother of planting. Similarly groundnuts give a very low yield if planted among rows of cotton, and cleaning the fields is more difficult. If cotton and maize are planted in alternate rows the cotton is so suppressed that the yield is negligible. There is little doubt that for maximum returns crops must be planted in pure stand in this area. Further experiments are being made with planting cotton among wide-spaced maize, not with the idea of increasing cash returns per acre, but to encourage new people to plant cotton among maize because they will obtain a food supply at the same time as they are earning some cash.

Rotations and Fertilizers

There has only been one experiment with different rotations; the only positive result was that maize yields more when planted after groundnuts than after cotton. In one year the increase was 40 per cent. and another year only 10 per cent. The rotation finally adopted is cotton, maize, cotton, groundnuts and maize, the last being interplanted with rest crops. This rotation is not designed to be suitable for peasant cultivators, but has been adapted to meet the needs of the Station; the chief needs are an adequate acreage of cotton for experimental purposes, and the provision of food crops for the labour force; at the same time the fertility of the soil must be maintained and if possible improved.

This rotation of five years' cropping followed by four years' rest under

a mixture of elephant grass and pigeon pea is one which should maintain a good soil structure indefinitely. It also appears that there are enough plant nutrients in the soil to give continuous yields. Experiments on the use of compost have shown that yield increases are only obtained with uneconomically large dressings. Artificial fertilizers, owing to their high cost and the low value of the crops grown on the Station, have not been considered important. One experiment with artificials was made, but no increases in cotton yield were found, nor were there any residual effects on maize the following year. New fertilizer experiments are being planned, and only the future can prove if the above cropping scheme will maintain yields at their present level. It is hoped, however, that neither artificials nor compost will be needed for a long time to come.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA AND IN PAKISTAN

133. INDIA'S COTTON PROBLEM. (*Man. Guar.*, 11/2/48.) The *Indian Cotton Review*, published by Chunilal Mehta and Co., Ltd., in its latest issue, covering 1946-47, contains an interesting analysis of the situation created in East Indian cotton by the separation of Pakistan from India. The review is concerned primarily with India's position, which is shown to be one of very great difficulty. It is estimated that in 1946-47 India's consumption of Indian cotton was some 500,000 bales larger than its production. In cotton of $\frac{13}{16}$ in. and longer staples India's consumption and exports totalled 975,000 bales, or 375,000 bales more than her own production of cotton in that category, while most of Pakistan's production of 1,075,000 bales of long staples was surplus to Pakistan's own requirements. In the medium staples Indian exports and consumption, at 1,575,000 bales, were 500,000 bales larger than her production, while Pakistan had an exportable surplus of 450,000 bales. Indian production even in short staples, at 975,000 bales, was 75,000 bales less than her consumption and exports. In view of this statistical position it is not surprising that India has become reluctant to permit cotton exports and has begun to display anxiety about securing supplies from East Africa, Egypt, and elsewhere as an insurance against possible failure to arrange for supplies from Pakistan. Another consideration to which the figures draw attention is India's need to increase production of short-stapled cottons as well as the medium and longer types.

134. INDIA AND PAKISTAN: TRADE IN RAW COTTON. (*Man. Guar.*, 24/2/48.) All ceiling and floor prices for Pakistan cotton were abolished as from February 23, and at the same time the export duty was raised from Rs. 40 to Rs. 60 per bale. The new duty is equivalent to about $2\frac{3}{4}$d. per pound, showing a rise of about $\frac{9}{10}$d. per pound, and on February 23 prices of Indian cotton at Bombay rose by about Rs. 16 per kandy—say $\frac{3}{8}$d. per pound. These developments appear to be further moves in the campaign by which India hopes to secure Pakistan long-stapled cotton and Pakistan hopes to obtain Indian cotton textiles. Whatever the motives behind recent changes in both India's and Pakistan's arrangements for exports of raw cotton may be, however, they undoubtedly create very difficult conditions for those who wish to buy cotton from either of these countries.

135. INDIAN COTTON INDUSTRY: REORGANIZATION. By V. Lallubhai. (*Text. Wkly.*, **40,** 1947, p. 934. From *Summ. Curr. Lit.*, xxvii, **24,** 1947, p. 586.) Extracts are given from a recent book, *Towards Increased Cloth Production*, in which the author discusses the acute shortage of yarn and cloth in India, and argues that if every Indian mill spun 20 per cent. coarser and restricted cloth output to a few sorts the mills would produce more cloth and have yarn available for the hand-loom industry. He describes the reorganization of the Rohit Mills, Ltd., Ahmedabad, on such a basis.

136. PAKISTAN COTTON RESOURCES. (*Ind. Text. J.*, **57,** 1947, p. 1037. From *Summ. Curr. Lit.*, xxvii, **22,** 1947, p. 509.) Almost all the long-staple cotton of India and a good proportion of short- and medium-staple cotton is grown in Pakistan areas. In fact, the best cotton tracts from the point of view of yield per acre and quality are situated in Pakistan. Figures and estimates of acreage and output, and yield per acre, are given. In normal years nearly half of India's total exports have been accounted for by cotton grown in Sind and the Punjab, and the United Kingdom will figure as the best market for Pakistan cotton.

137. INDIAN COTTON: WAX CONTENT AND FEEL; ESTIMATION FROM PHYSICAL CHARACTERISTICS. By C. Nanjundayya. (*Ind. Text. J.*, **57,** 1947, p. 899. From

J. Text. Inst., xxxviii, **11**, 1947, A515.) Ahmad and Sen (1934) established a relation between wax content of cotton and the grader's estimation of feel. In the present work an attempt is made to correlate wax content and feel with some physical characters of cotton. Wax content is highly correlated with the surface area per gram, which, in turn, is a function of the ratio Ribbon-width/Fibre-width per unit length. This latter ratio, expressed in English units, directly gives the experimental value of wax content of a cotton, the calculated value being in close agreement with the experimental value in the majority of cases. It is deduced that the coating of wax is nearly the same for all cottons and its distribution on the fibre surface is fairly uniform. "Feel" of a cotton, as ordinarily estimated by an expert grader, is related primarily to the fibre-weight per unit length or to the ratio of ribbon-width to the fibre-weight per unit length. Scales of fibre-weight per unit length, and the ratio of the ribbon-width to the fibre-weight per unit length for classifying cotton into different grades of "feel" are given for the first time. There are 30 references to the literature.

138. AMERICAN COTTONS IN INDIA—THEIR INTRODUCTION AND DEVELOPMENT. By M. Afzal. (*Indian Frmg.*, vii, **10**, 1946. Received 1948.) American cotton seed was first introduced into India in 1818, but early efforts to acclimatize it were, in the main, failures. In 1840 experiments in the Bombay Presidency were successful in establishing the New Orleans cotton, and the area under it increased rapidly. After several failures, therefore, the American cotton plant was acclimatized in India during the 19th century, and the beginning of the present century saw its spread on a wide scale. With the inauguration of the Indian Central Cotton Committee in 1921 the work of improvement in yield and quality of American cottons was accelerated by the appointment of special staff in most of the cotton-growing provinces and States, with the result that the improved strains are now grown over millions of acres in India. A list is given of the most important varieties at present under cultivation, and their technological properties are described.

139. SYMPOSIUM ON STATISTICAL METHODS IN PLANT AND ANIMAL BREEDING. (*Proc. of Ind. Acad. of Sciences*, xxv, **5**, Ser. B, 1947.) At the meetings held at Allahabad in December, 1946, under the auspices of the Indian and National Academies of Science, Dr. V. G. Panse discussed the various problems in connection with plant breeding, which, in his view, could be divided into the following three groups: (i) The choice of material from which to breed; (ii) the actual process of selection; (iii) the maintenance of superior strains once these had been evolved. Dr. Panse stressed the need for a study of quantitative genetics. The earlier expectation that genetics would revolutionize plant breeding had not been borne out mainly because genetical investigation had been restricted to the formal Mendelian characters, while the study of quantitative characters, which were the ones with which the breeder was really concerned, had lagged far behind. This study could be pursued with the help of statistical methods coupled with adequate experimental material, and provided a very rich field for co-operative work by statisticians, geneticists, and breeders.

Dr. Sukhatme led the discussion on the animal breeding side, and other matters discussed at the meetings included: the application of the method of discriminant function (K. Kishen, V. D. Thawani); the relationship between hybrid vigour and F_2 and F_3 variances in the light of a simple Mendelian scheme of factors (S. D. Bokil); hybridization (R. S. Koshal).

140. THE KEY TO THE GROWER'S DOOR. By Sir Roger Thomas. (*Ind. Cott. Grwg. Rev.*, i, **2**, 1947, p. 77.) The author points out that progress has been very slow in applying the results of research to agriculture in India, but he is of opinion that the tempo of progress can be considerably hastened without great cost. There is little hope, however, for any material change unless the villagers can be contacted *collectively*. This object can be achieved by taking the fullest advantage of the appliances which science and technology have now made available. These are the mobile cinema and the radio. For village welfare work the mobile cinema excels;

the radio will take second place as a medium for educative publicity until the illiteracy of the agricultural masses has in large measure been liquidated.

141. BARODA: COTTON CULTIVATION. (*Ind. Frmg.*, viii, 4, 1947, p. 206.) Cotton is the major crop of Baroda. The old Goghari mixture has been replaced entirely by Suyog in Navsari district and Vijaya in Baroda district. Wagattar cotton was introduced in Mehsana district and subsequently in Amreli district. A scheme to improve the Mathio cotton of Kathiawar was started in 1938, and the work resulted in the selection of the S31 strain, which was named Pratap. The extension of this type was undertaken in collaboration with the Indian Central Cotton Committee and the neighbouring States of Bhavnagar, Junagarh, and Palitana, and will replace the Mathio mixture on about 600,000 acres.

142. BREEDING OF HIGH GINNING JARILA COTTON. By T. R. Khadilkar. (*Ind. Cott. Grwg. Rev.*, i, 2, 1947, p. 64.) A cross has been made between Jarila, a highly wilt-resistant Khandesh cotton, and N.R.5, a high-ginning type. Three cultures, 197-3, 403-5 and 670-4, have been obtained giving a better ginning outturn by 2 to 4 per cent., and also a better yield by about 15 to 20 per cent. than Jarila. These results were confirmed by practical tests carried out in 1945. Further trials and the development of new crosses are being carried out.

143. EFFECT OF APPLICATION OF SMALL DOSES OF NITROGEN TO COTTON. By D. V. Narayanayya. (*Ind. Cott. Grwg. Rev.*, i, 3, 1947, p. 143.) An experiment laid out at Parbhani during the years 1943 to 1945 to test the efficiency of applications of small doses of nitrogen to cotton is described. Data relating to germination, final stand, yield of *kapas*, and earliness are discussed. Under the soil and climatic conditions prevailing at Parbhani the application of ammonium sulphate at 5 lb. of nitrogen per acre is sufficient to increase the yields of cotton significantly. This increase may vary from 30-60 per cent. depending upon rainfall conditions. The fertilizer should be applied at the time of sowing. Drilling it along with the seed is a better method of application than coating the seed with the fertilizer. The latter method has a detrimental effect on the germination if dry conditions prevail at the time of sowing.

144. STUDIES IN THE GENETIC CONSISTENCY OF GAORANI 6. By P. D. Gadkari *et al.* (*Ind. Cott. Grwg. Rev.*, i, 2, 1947, p. 65.) A report of an investigation undertaken to find out whether any genetic changes take place in Gaorani 6, an improved strain of *G. arboreum* var. *neglectum* forma *indica*, during the course of its propagation. The results indicated that the strain does not undergo any genetic change during the course of its multiplication up to the seventh stage with regard to viability, yield, earliness, plant vigour, staple length, weight of 100 seeds, fibre-weight, swollen hair diameter, fibre maturity, and spinning performance. There is, however, a slight tendency—statistically significant in one year only—for the ginning percentage to go down, due to development of less number of fibres per seed.

145. A REVIEW OF EXPERIMENTS WITH LEGUMES PRECEDING COTTON IN THE MADRAS PROVINCE. By R. Balasubrahmanyan and S. Sundaram. (*Ind. Cott. Grwg. Rev.*, i, 2, 1947, p. 87.) The rôle of leguminous crops figuring in rotations with cotton in Madras is reviewed both from the experimental and utilitarian points of view. The data have been collected from the experiments carried out at the Agricultural Research Stations at Coimbatore, Koilpatti, Guntur, Nandyal and Hagari, and a short résumé of the agricultural background at each station is given. The review has amply demonstrated that in planning any future trials it will be unwise to go in for pulses other than groundnut, *tur*, gram, and horsegram for seed, and *pillipesara*, indigo, and *guara* for green manure.

146. INTRODUCTION OF CAMBODIA COTTON IN THE CEDED DISTRICTS OF MADRAS PROVINCE. By K. D. Rajulu. (*Ind. Cott. Grwg. Rev.*, i, 2, 1947, p. 84.) All the five varieties of cotton cultivated in the Ceded Districts, with the exception of Mungari, have poor yields and low ginning outturn. The lint of Mungari, however, is short and coarse and unsuitable for spinning higher than 8s or 10s. Attention

has therefore been directed to the introduction of American cottons, and preliminary trials have shown that they can be successfully cultivated as a *rabi* (winter) crop. Under a scheme sanctioned by the Indian Central Cotton Committee, 156 *hirsutum* varieties under irrigation and 141 under rainfed conditions were tested at various centres in suitably replicated yield trials. Hyderabad-American H.A.11 was found to be the most desirable type in respect of yield, fibre properties, adaptability, and low percentage of bad seed cotton. Further study is being carried out on this variety.

147. Problems in Cotton Improvement in the Punjab—I. By M. Afzal. (*Ind. Cott. Grwg. Rev.*, i, **2**, 1947, p. 50.) An account is given of the climatic conditions, area, and production, and the varieties of cotton grown. A map is included of the six ecological regions and of the Cotton Research Sub-Stations. The problems in connection with cotton improvement in the Punjab are discussed under the headings: Improvement in yield; improvement in ginning outturn; improvement in staple; resistance to pests and diseases; cultural practices.

148. Problems in Cotton Improvement in the Punjab—II. Improvement of Yield. By M. Afzal. (*Ind. Cott. Grwg. Rev.*, i, **3**, 1947, p. 151.) With the possible exception of Sind, the yield of cotton in the Punjab is the highest in India, and there is a marked upward trend. The Indian Central Cotton Committee has financed a scheme for the supply of pure seed in the Punjab, and it is expected that cotton yields will improve still further. It is pointed out that yields during the past twenty years are mainly due to the introduction of high-yielding varieties, and that better results will be obtained as farmers in the Punjab modernize their agronomic practices. Another factor responsible for the lower yields in the Punjab compared with some foreign countries is the absence of effective pest control measures.

149. Improvement of Cotton in Middle Gujarat. By P. L. Patel. (*Ind. Cott. Grwg. Rev.*, i, **4**, 1947, p. 184.) The cotton tract of the Middle Gujarat is described. Research work on the improvement of Broach cotton—the main commercial variety of Middle Gujarat—has been in progress since 1913. In 1932 the Bombay Dept. of Agriculture, with the aid of funds from the Indian Central Cotton Committee, launched the "Broach Cotton Breeding Scheme" to evolve 100 per cent. wilt-resistant, high ginning, high spinning, and good yielding strains of cotton to replace the high ginning but wilt-susceptible and poor spinning Goghari mixture grown in the Broach tract. In all, 23 segregates from different crosses and back-crosses with the combination of ginning percentage 37 to 44, staple length 0·84 in. to 0·92 in., spinning value 27 in. to 42 in. warps, high wilt resistance and good yield are now maintained. Of these, segregates 1-2 and 1-6 (named Vijay) are the best. Further research work on the improvement of fibre length and breeding for early maturity is under way.

150. Cotton Growing in Sind. By R. Sankaran. (*Ind. Cott. Grwg. Rev.*, i, **3**, 1947, p. 107.) An historical review of cotton growing in Sind is given, climatic conditions are described, and agronomic factors are discussed. A scheme has recently been sanctioned for hybridization work between *barbadense* and *hirsutum* cottons, and will soon come into operation.

COTTON IN THE EMPIRE

151. Canada: Loan from U.S.A. (*Cott. and Genl. Econ. Rev.*, 23/1/48.) A report from the *Canadian Press*, January 15, is to the effect that the U.S. Export-Import Bank has agreed to provide Canada with a loan of $30,000,000. At present prices this would suffice to finance the import of about 150,000 bales of U.S.A. cotton.

152. Ceylon: Cotton Industry, 1945. (*Admin. Rpt. of Actg. Dir. Agri.* **1945.** Received 1947.) Samples of lint of the selection BP.79 were sent to the Technological Laboratory of the Indian Central Cotton Committee for spinning tests. The tests indicated that the selection is suitable for spinning up to 41s. When it

is remembered that the Wellawatta Mills complained that the Cambodia cotton supplied to them under the Purchase Scheme did not spin a 30s count, the progress achieved with the BP79 selection will be appreciated. BP79 yields over 7 cwt. seed cotton per acre, and possesses a staple of over $1\frac{1}{8}$ in.

At Hambantota a start has already been made with the large-scale production of selected seed of BP79 for distribution to growers. Selected seed of BP79 is being raised for a 100-acre seed multiplication block at Wirawila, 1946-47. A 10-acre Cotton Breeding Station was opened at Hambantota in August, 1945, for the maintenance of 14 medium-staple cottons now acclimatized over a period of six years. The distinctive morphological characters of these varieties are being studied. A programme of cotton breeding, cultural and manurial experiments is being planned for the station. A rotation trial has been set down at Wirawila to test the effects of two crop rotations and five lay treatments over a period of ten years. Cotton has been included in the rotation.

153. CYPRUS: COTTON INDUSTRY, 1946. (*Ann. Rpt. Dpt. Agr.*, 1946. Received 1948.) During the war years the area under cotton was considerably reduced. In 1946 there was a good local demand, but the price of 4s. per oke (2·8 lb.) offered by the Government Spinning Mill realized only about 10,000 okes. Towards the end of the year imports of Egyptian cotton were made, therefore, for this mill. Inadequate supplies of spring flood and summer irrigation waters limited the crop area somewhat, but production per donum ($\frac{1}{3}$ acre) was normal. The variety Coker 100, which is being grown in segregated areas, is gaining in popularity.

154. AFRICA. NIGERIA: COTTON PROSPECTS, 1947-48. (*Half-yrly. Rpt.* to December, 1947.) *Northern Provinces.*—The season has not been as favourable as 1946-47 for cotton, especially in the main cotton belts. Rains in southern Katsina were 20 per cent. below average, and ended early, being closely followed by harmattan conditions. The early onset of the harmattan at the optimum flowering stage caused much boll shedding coupled with early maturing of the crop. Apart from Katsina, Sokoto and Zaria Provinces, growing conditions elsewhere were average. Quality has been generally satisfactory, and shows, if anything, a slight improvement over the previous season. Bollworm attack is still considerable, and damage has also been caused by the Red Bollworm and the False Codling Moth.

A very large amount of cotton is being sold to traders on behalf of the local spinning and weaving industry; this demand is exceptional, being caused by the continued scarcity of imported textile goods. It is reported that quantities of cotton have been sold over the border into French territory from N. Katsina. Owing to all these factors it is estimated that the amount of cotton available for export will be less than that for the previous season. An adjustment in the price of cotton has been made for the 1947-48 season on advice from the Board of Trade. The ginnery price for N.A.I has been raised from 2·7d. to 3d. per lb. and that for N.A.II from 2·6d. to 2·75d. per lb. The gap between Grades I and II has been widened in the hope that this will prove an incentive to farmers to market best-quality cotton. In the main cotton belt market prices for Grade I vary from 2·7d. to 2·4d. per lb. according to the transport differential from market to ginnery. For Grade II the corresponding figure is 2·5d. to 2·1d. per lb. The revised prices give the cultivator $\frac{2}{10}$d. to $\frac{3}{10}$d. more than the 1946-47 season for Grade I and $\frac{1}{10}$d. to $\frac{2}{10}$d. more for Grade II.

Western Provinces.—Owing to the failure of the Ibadan selection and multiplication plots there was no seed available for planting in the Meko No. 1 area in 1947. . . . There has been a considerable decrease in seed distribution in all provinces in comparison with previous years, but it is estimated that the acreage actually planted is as great as, if not greater than, last year. Farmers are either planting native cotton or using their own Ishan seed. The demand for seed cotton for the local spinning and weaving industries is very great, and prices of seed cotton in local markets for this purpose are normally considerably higher than for Improved Ishan for export. Weather conditions generally were favourable throughout the

Western Provinces, and the growth of the crop is everywhere reported to be satisfactory. *Helopeltis* damage has been severe in the northern Ekiti division of Ondo Province and in parts of Oyo Province; the drier areas have suffered most. In districts where *Helopeltis* damage is not serious the crop prospects are good. Mr. J. B. Hutchinson, Cotton Geneticist, and Mr. E. O. Pearson, Entomologist, of the Empire Cotton Growing Corporation, made a tour of the Western Provinces in December, 1947, to make a general survey of the types of cotton cultivated, and the incidence of pests and diseases.

155. Nyasaland: Cotton Industry, 1946-48. A report from the Dept. of Agriculture dated December 19 states that cotton buying has now ceased on the Lower River, with a total of 5,269 short tons of seed cotton, thus exceeding the estimate by 24 per cent. The total output for the Southern and Central Provinces for the season is just short of 5,600 tons.

In view of the high prices paid interest in cotton growing is keen, and a substantial increase in acreage is expected in the 1947-48 season. Considerable difficulty has been experienced in the delivery of seed owing to the shortage of bags.

156. Cotton Prospects, 1948. A report from the Dept. of Agriculture, of December 31, states that on the whole the weather during the month was conducive to a good start for annual crops. Rainfall was ample and fairly well distributed with the exception of the Fort Johnston area, where it was excessive and equalled a record which has stood for 43 years, and the northern part of the Central Province and Mzimba, where no more than 3-4 inches were recorded. Seed issue began on December 29 in the main cotton-growing area of the Lower River. In the Central area germination has been good, but it is doubtful whether the early expectation of a large crop will be sustained. The estimated winter crop of Karonga is expected to reach 400 short tons of seed cotton.

157. Cotton Legislation. (*Rpt. on a Fiscal Survey of Nyasaland*, 1947.) The Cotton Ordinance, No. 16 of 1934, gives the Director of Agriculture powers to control the type of seed grown and to control markets. It also gives the Governor powers to fix minimum prices to the producer and to fix maximum prices which the ginnery may charge for ginning and baling of other people's cotton. Power also exists to declare any segregated areas for the controlled multiplication of new varieties of cotton. Under this ordinance also no new ginneries may be erected without permission. The Crown Land Cotton (Tax) Ordinance, No. 1 of 1935, imposes a tax on seed cotton produced by natives on Crown Lands of a maximum rate of 6d. for every 100 lb., the proceeds to be used exclusively in the interests of the industry of cotton planting by natives on Crown Lands.

158. Northern Rhodesia: Cotton Textiles. (*Crown Col.*, January, 1948, p. 45.) The Governor stated to the Legislative Council that with purchases of cotton piece-goods from India, the U.K., Japan, Hungary, and the U.S.A., there are prospects that the territory's minimum requirements for its African trade will be met, but "there is not yet that abundance of supplies of these and other consumer goods which would give the best stimulus to increased effort and production by the African community.

159. Southern Rhodesia: Bulletin for Cotton Growers. By G. S. Cameron. (*Rhod. Agr. Jour.*, xliv, 5, 1947, p. 498.) A very informative account of the cotton industry in Southern Rhodesia discussing the following: Cotton as a rotation crop; cotton as a trap crop for eelworm; choice of land; preparation of soil; planting; depth regulators; machine planting; hand planting; acid-delinted cotton seed; thinning out or singling; cultivation and weeding; early growth; fertilizers; compost; harvesting; mechanical harvesting; ginning fee; payment for crop; packing of cotton; marking of woolpacks; delivery of cotton; seed supply. In conclusion, the writer gives the following advice to those who contemplate cotton growing: (1) Prepare land in plenty of time, and secure a good, even tilth; (2) Order seed well in advance; (3) Plant shallow and as early as possible within reason—say, in November; (4) Use plenty of seed; (5) Early thinning and cleaning are both essential; (6) When in

doubt, do not hesitate to write and ask for guidance. It is also pointed out that ratooning of cotton and/or allowing it to stand over in the field from one season to another is prohibited.

160. TANGANYIKA: COTTON INDUSTRY. (*E. Afr. and Rhod.*, 22/1/47.) Tanganyika's plans to help itself and the sterling area in present difficulties have been discussed by the Legislative Council. The Director of Agriculture stated in regard to the cotton industry that "the work of the Empire Cotton Growing Corporation has proved very successful, and we are already multiplying seed from which we can guarantee from 1951 onwards to give an average yield of at least 50 per cent. more cotton than we are getting in the Lake Province at present. In other words, instead of an average crop of 30,000 to 35,000 bales we can guarantee an average crop of 50,000 bales from 1951. Cotton of our quality is in great demand in the United Kingdom."

161. COTTON INDUSTRY, 1947. (*E. Afr. and Rhod.*, 15/1/48.) Early in the year the cotton crop was expected to be just under 50,000 bales. Excessive rain, and then jassid damage in the Lake Province, interfered with the developing crop, followed by a very severe plague of field mice and an increase in bollworm damage in the Eastern Provinces. The final figure was given as 39,000 bales, 2,000 bales less than the 1946 crop.

162. COTTON PROGRESS, 1948. A report from the Department of Agriculture, dated February 10, states that early rains in the Lake, Western, Central, Southern and Southern Highlands Provinces were patchy, but, except in Sukumaland, satisfactory falls took place in January. Short rains were light in the Tanga Province, and the Bagamoyo, Uzaramo and Moshi districts, but were adequate elsewhere in the Eastern and Northern Provinces. Cotton planting in the Lake Province was more advanced than that of food crops. The Eastern Province crop at 6,100 bales was better than at one time expected, when neglect of the crop was attributed to lack of trade goods in the shops. Marketing of a disappointing crop was in progress in the Tanga and Northern Provinces.

163. UGANDA: COTTON EXPERIMENTAL WORK, 1945-46. (*Ann. Rpt. Dpt. Agr. Exp. Work*, 1945-46. Received 1948.) The results are given of experiments carried out at Serere and Bukalasa to test the value of applications of cotton seed and cottonseed meal as fertilizers for the cotton crop. Studies of cotton capsid bugs were continued at both Stations, and the general conclusions reached were that the incidence of *Lygus* on cotton was related to climate through the influence of the latter on alternate host plants. Observations in 1945 failed to show that *Lygus* caused serious loss of basal sympodial structure. No clear relation between *Lygus* attack and cotton yield could be demonstrated. The incidence of cotton stainers and bollworms was also studied. Reports are included on agricultural, genetical, and breeding work carried out at Serere and Kawanda, and of the manurial and fertility experiments at Bukalasa. In Masaka district the experiment with late sowing of cotton proved unsuccessful owing to adverse weather conditions. In the Western Province a grass-growing trial at Ngetta indicated that cotton gave higher yields after grazing. At Serere the results of cultivation experiments after early opening up of land indicated that bi-monthly cultivations increased the yield of cotton in the case of early opening up (August-October), but had no effect on the later opening up (February). A summary is included of the 1945 fertility experiments with cotton and other crops.

164. COTTON PROSPECTS, 1947-48. (*Cott. and Genl. Econ. Rev.*, 13/2/48.) A report from the Department of Agriculture of January 30 states that all zones received some rain during the first two weeks of December, but this came too late to benefit the late plantings, which in all areas are stunted and bolling prematurely, and will produce little crop. Picking was general on early and main plantings and grade is reported to be satisfactory. Total purchases in Usuku zone amounted to 2,075 bales approximately. The total crop for the Protectorate is now estimated at 170,000 running bales.

165. Cotton Industry, 1947-48. (*E. Afr. and Rhod.*, 15/1/48.) Trade has continued fair, with stocks of piece-goods in the hands of the buying pool sufficient for immediate needs. . . . Generally, the native seems to be conserving what resources he has, and no great improvement in trade is now looked for until the advent of the cotton season.

Recent rains have brightened prospects for the cotton crop in Buganda, but have come too late in the Eastern Province to be of any benefit. Unofficial estimates of the Protectorate's crop for 1947-48 are between 150,000 and 160,000 bales.

166. Cotton Marketing, 1948. (*Cott. and Genl. Econ. Rev.*, 23/1/48 and 20/2/48.) A report of January 22 is to the effect that during the week 6,400 bales were offered against private tenders, and still higher prices are reported to have been obtained. Competition between France and India was particularly keen. Prices paid for BP.52 are said to be around 26d. per pound. Next week the Government will offer up to 10,000 bales, but this time the cotton will be sold by public auction. The recent method of selling against private tenders met with numerous complaints, particularly the difficulty potential buyers experienced in determining what prices to bid when nothing was disclosed regarding terms of accepted tenders.

A report of February 17 states that at this week's open auction 10,000 bales were sold on Government account at the record high average price of 32d. per lb. Prices paid for BP.52 were rather more than this figure and those for shorter staples somewhat less. A further 10,000 bales will be offered on March 3, including 5,000 bales of BP.52.

167. AUSTRALASIA. Queensland Cotton Industry. (*Dalgety's Ann. Wool Rev.*, 1946-47. Received 1948.) In 1939 Queensland produced 12,447 bales of raw cotton as compared with the 1946 production of 2,372 bales. This decline was entirely due to war conditions. The cotton industry had no priority during the war, and any labour available in rural areas was concentrated on food production. . . . There is a market in Australia for the Australian cotton spinning mills of 100,000 bales of raw material each year, and when the trade comes back to somewhere near normal Australia will be importing cotton manufactured goods equivalent to another 200,000 bales a year. The potential home market for raw cotton, therefore, is a very large one, and if a comprehensive and constructive plan of water conservation and irrigation is implemented in Central and Southern Queensland, Australia's future cotton requirements can be successfully and profitably grown, resulting in the development of the nation's natural resources and a substantial increase in population and wealth. Developments are taking place in the world to-day which will revolutionize production in all its phases, and this will apply particularly to the cotton-growing industry. The indications are that within a reasonable period of time cotton will place Australia on the same footing as any other country in the world in regard to the cost of producing raw cotton. With the development of natural water resources and the application of mechanical harvesting, Australia should well be able to grow her own requirements of this important and basic fibre.

168. WEST INDIES. Peasant Agriculture in the Leeward and Windward Islands. Pt. I. The Development of Peasant Agriculture. By C. Y. Shephard. (*Trop. Agr.*, xxiv, 4-6, 1947, p. 61.) This article constitutes the first part of a report submitted to the Secretary of State for the Colonies. The subject is discussed under the following main headings: *Historical Introduction:* dealing with the Leeward Islands; the Old Colonial System; the System of Agriculture; Windward Islands; Emancipation; Free Trade; Land Settlement. *Labourers' Provision Grounds:* Slaves' Provision Grounds; Labourers' Provision Grounds. *Share Cropping. Montserrat*: Historical Outline; the Present System; Soil Erosion; The Share; Returns to Landowner. *Nevis*: Share-cropping system; Soil Erosion. *Cash Tenancy. Squatting. Freehold Tenure*: Leeward Islands; Windward Islands; Land Settlement; Disadvantages of Freehold.

COTTON IN THE U.S.A.

169. AMERICAN COTTON CROP: FACTORS AFFECTING 1947-48 SEASON. (*Rayon Organon*, 18, 1947, p. 148. From *J. Text. Inst.*, xxxix, 1, 1948, A2.) Factors bearing on the United States cotton situation during the 1947-48 season are considered, including a brief review of pre-war, wartime, and post-war trends in world raw cotton production and distribution. Yearly figures for the last ten years of world production, world consumption, and world exports of raw cotton are presented and discussed. It appears that both the world and U.S. supply of cotton during the 1947-48 season will be more than sufficient to meet indicated demand requirements in the United States and abroad. United States cotton production, consumption, exports, stocks, and the various government domestic and export control programmes are examined with regard to their effect on the 1947-48 cotton situation. The United States cotton crop in the current season is expected to increase substantially over the preceding season, but domestic consumption and exports are expected to decline.

170. AMERICAN COTTON CROP, 1947-48. (*Cotton*, M/c., 31/1/48) Although cotton ginned from the present American cotton crop is officially reported higher in grade than the previous crop, it is shorter in staple length and a relatively tight supply situation with respect to 1⅛ in. cotton and longer is indicated. Advices from the South confirm the shortage of long staple cotton, and emphasize that some merchants are now declining commitments for future delivery of the high-grade staple variety.

171. COTTON INDUSTRY, 1948. (*Overseas Rev.*, Barclays Bank (D.C. and O.), January 1948.) Cotton shipments from the U.S.A. for the first four months of the new season have been extremely low, and it is expected that the Marshall Plan will have to supply the greater part of future sales. The market has shown a stronger trend since a recent speech by Secretary of State Marshall, stating that if Congress approved the European Relief Programme the United States would ship three million bales during the fifteen months commencing April 1 next.

172. WORLD SUPPLY AND DISTRIBUTION OUTLOOK FOR AMERICAN COTTON, 1947-48. (*Cotton*, M/c., 7/2/48.) An analysis of prospects regarding distribution of cotton in the United States and abroad suggests a world consumption of American cotton for this season of around 12,400,000 bales. This would be about 600,000 bales smaller than last season's estimated total of 12,959,000, but it would be higher than the average consumption of the preceding ten seasons of about 11,750,000 bales. A world consumption of 12,400,000 bales, plus a small allowance for cotton destroyed during the season, would suggest a world carryover of American cotton on July 31 next of about 4,100,000 bales, as compared with 5,250,000 at the end of last season, and a preceding ten-year average of about 11,500,000 bales.

173. COTTON MILL REQUIREMENTS AS RELATED TO IMPROVED COTTON QUALITY AND MARKETING PRACTICES. By F. L. Gerdes and A. Y. Willis, Jnr. (U.S. Dept. of Agr. Prodn. and Marketing Admin., Cott. Branch. Washington, D.C., 1947.) In this preliminary report the following matters are discussed: The need for information on cotton quality requirements of the textile industry; Qualities of cotton required for various types of products; Factors determining the quality of cotton consumed: quality specifications for end products; economy of raw cotton and of processing; Improved processing equipment and practices contributing to manufacturing efficiency; Methods of obtaining qualities of cotton required: customary classification a basis for quality description; methods for supplementing classification in quality evaluation; variety and place of growth important factors; fibre laboratory tests supplement classification; Trade channels for obtaining mill requirements; Basis for acceptance by mills of deliveries of cotton.

174. ARIZONA: COTTON SELECTION WORK, 1944-45. (*56th Ann. Rpt. Univ. Ariz. Agri. Exp. Sta.*, 1944-45. From *Pl. Bre. Abs.*, xvii, 4, 1947, p. 422.) Selection of the Upland cottons, Acala and Stoneville 2B, is reported. Selection for several characters was carried out in the following hybrids and backcrosses: Santan

(Shafter type Acala) x 1517 (New Mexican Acala); Santan x Stoneville 2B; Santan x Wilds No. 13; Santan x (Santan x 1517); 1517 x (Santan x 1517); Santan x (Santan x Wilds No. 13); and Wilds No. 13 x (Santan x Wilds No. 13). In breeding long staple cotton, F_3 selfed families of the second backcross of Tanguis x Pima to Pima were studied with regard to fibre length, fineness and strength, seed weight per 100 grms., lint percentage, and lint index.

175. Arkansas: Cotton Varieties. (*Bull.* 464. *57th Rpt. Ark. Agr. Exp. Sta.*, 1946. From *Pl. Br. Abs.*, xvii, 4, 1947, p. 420.) The new varieties, Arkot 1 and Arkot 2, selected from Rowden and Stoneville 2B, respectively, were released. Arkot 1 has outstanding fibre quality; in tests during the past three years it has proved highly resistant to *Fusarium* wilt. Arkot 2 is similar to Stoneville 2B in plant characters, but somewhat more resistant to wilt.

176. Georgia: Empire Cotton. (*59th Ann. Rpt. Ga. Exp. Sta.*, 1946-47. Received 1948.) Further expansion of the Empire cotton breeding programme has been necessary in order to provide adequate supplies of foundation seed needed to meet the increasing demand for this cotton. Parent seed of Empire cotton produced by the Experimental Station is supplied to farmers in organized one-variety communities at Haralson, in Coweta County, and at Tyrone, in Fayette County, under agreement to plant no other cotton on their farms or within 500 yards of any other variety grown on other farms. Cotton produced by farmers in these communities, from fields which meet all requirements for isolation, is ginned on one-variety gins restricted to Empire cotton, and the seed produced by the growers is certified as foundation or "breeder" seed of Empire, and is distributed from Haralson in sealed bags. It is anticipated that between 500 and 600 tons of foundation seed will be produced in 1947 Under the Empire breeding programme, foundation seed is released during the fourth or fifth year of multiplication after the progeny row stage—depending upon the productivity of increase plots and upon the number of increases that maintain suitable qualities during successive years of multiplication. Tests for productivity, wilt resistance, and fibre qualities are made on the second and third-year increases in order to determine the best strains to be used for final multiplication.

Hybridization work with Empire Cotton.—Varieties of cotton having plant or fibre qualities of special value are being hybridized with wilt-resistant strains of Empire cotton in order to develop new improved types of cotton. The work was started in 1945 and most of the 1947 hybrid material is in the second generation or in the first backcross generation. Hybrids between Empire and Stoneville 20 were made in 1945. Stoneville 20 is highly resistant to blackarm disease. Second generation plants grown in 1947 will be inoculated with a culture of the bacteria causing the disease in order to identify susceptible and resistant plants. By recurrent backcrossing it is expected that resistance to blackarm can be transferred to wilt-resistant strains of Empire without loss of the characteristic qualities of the strain. Similar hybridization and backcross methods are being used to improve further the tensile strength of Empire fibre. Crosses between the Hopi and Acala varieties have shown exceptionally high tensile strength of fibre, and this hybrid strain has been crossed and backcrossed with wilt-resistant strains of Empire.

177. Wilt Resistance in Empire Cotton. By A. L. Smith and W. W. Ballard. (*Phytopathology*, xxxvii, 6, 1947, p. 436. From *Rev. App. Mycol.*, xxvi, 12, 1947, p. 543.) The original parent of Empire, a promising cotton variety now in the third year of commercial production in Georgia, was re-selected in 1935 from a field planting of Stoneville 2 first selected in 1931. A number of lines have been selfed continuously since 1938, and tests of these from 1944 to 1946, inclusive, revealed a wide range of reaction to wilt (*F. vasinfectum*) extending from high susceptibility to resistance on a par with that of the best commercial varieties. The heterozygosity of the original plant expressed in these variations suggests its probable derivation from a cross between Stoneville and a wilt-resistant variety. The uniformity of

the selfed lines for agronomic characters facilitated an immediate shift in production to those with a high degree of resistance.

178. COTTON VARIETY TESTS, 1946-47. (*59th Ann. Rpt. Ga. Exp. Sta.*, 1946-47. Received 1948.) Wilt-resistant Empire and CSS 3720 produced the highest average yield and acre value in the 1946 variety tests. CSS 3720 has been developed from a cross between Stoneville 2B and Clevewilt, backcrossed to Stoneville. This variety has not been grown commercially except for a limited acreage in the vicinity of Vienna, Georgia, where it has given good results in 1945 and 1946. Seed of CSS 3720 is not yet available for distribution. Wannamaker's Stonewilt and Coker 100 Wilt, both wilt-resistant varieties, are adapted for production under wilt conditions in south Georgia and in the Piedmont section of the State.

Wilt Resistant Empire and Stoneville 2B were the only varieties which produced fibre averaging $1\frac{1}{16}$ in. or better in length. . . . During the period from 1944 to 1946 CSS 3720 and Empire have averaged over $6 per acre more than the nearest commercial variety and more than $16 per acre above the lowest variety.

179. COTTON SEED TREATMENT. (*59th Ann. Rpt. Ga. Exp. Sta.*, 1946-47.) See Abstract 221.

180. MISSISSIPPI: COTTON INVESTIGATIONS. (*58th Ann. Rpt. Miss. Exp. Sta.*, 1944-45. Received 1948.) In July and August erosion losses were less from cotton following vetch than from cotton following a non-legume. Losses from a good stand of cotton were far less than from bare land. Cotton following vetch which had been hoed in lost less soil than following vetch spaded under. The soil saving by the mulch tended to become somewhat less, however, during the latter part of the season.

When cotton seedlings were grown in nutrient solutions containing ammonium and nitrate nitrogen under aerobic and anaerobic conditions, the absorption of both nitrate and ammonium nitrogen was greater under aerobic conditions. The percentages of nitrogen, phosphorus, potassium, calcium and magnesium in leaves were also higher for cotton plants grown under aerobic conditions.

181. COTTON EXPERIMENTS, 1945-46. (*59th Ann. Rpt. Miss. Exp. Sta.*, 1945-46.) The results are given of tests carried out with 12 varieties of cotton grown in 7 locations in the Yazoo-Mississippi Delta. The tests included staple length, earliness, lateness, fibre strength, fibre length uniformities, oil content, etc. Wilds 17 had the longest staple length, $1\frac{1}{4}$ in., and was also outstanding in fibre strength. The earliest cottons were Bobdel, and the Delfos strains 651, 531C, 9169, and 444. Deltapine 14 and Wilds 17 were the latest cottons. In fibre length uniformities Miller, Deltapine 14, Bobshaw 1 and Bobdel averaged better than other varieties in the test. The Delfos strains 531C, 651, and 9169 had the highest oil content (21 per cent.); Coker 100-9 and Coker 100 Staple the lowest oil content (18 per cent. and 18·8 per cent., respectively).

Several new strains of Delfos have been selected and increased, which yield considerably more than the old standard Delfos cottons, and at the same time have higher ginning outturn, longer staples, large bolls, and are considerably easier to pick than the parent strain. Attempts are also being made to obtain high-yielding strains of Missdel, Deltatype Webber, and other cottons characterized by exceptionally good spinning qualities, but with low yields.

182. TESTS OF COTTON VARIETIES FOR HILL SOILS, 1946. By J. F. O'Kelly. (*Bull.* 442. Miss. State Coll. Agr. Exp. Sta., 1947.) Weather and insect damage were very severe, and moderate yields were only possible by the use of calcium arsenate for boll weevil control. The results indicated that the varieties best suited to the hill areas of the State were the Deltapine and Stoneville strains, with Coker 100 Wilt coming to the front as a strong competitor. Empire, a Stoneville selection from Georgia, has made a very creditable showing since its introduction a few years ago. It yields quite well, and, like Bobshaw, has a strong fibre. It can be used more extensively as soon as an adequate supply of breeder seed is obtainable.

183. North Carolina: Cotton Experiments, 1946. (*Res. and Frmg.* *69th Ann. Rpt. Agri. Exp. Sta. N.C. State Coll. Agr. and Eng.*, 1946.) The results are given of experiments in connection with the value of winter cover crops on the increase of cotton yields; fertilization experiments with various rates of nitrogen, phosphorus, and potash, on Norfolk and Cecil sandy loam soils; factors affecting yield and quality of cotton; hybrid vigour in cotton; new insecticides for boll weevil control; the development of greater fibre strength through hybridization.

184. Texas: Effect of Immaturity on the Characters of Cotton Fibre, Yarn, and Seed. F. M. Eaton *et al.* (*Jour. Amer. Soc. Agron.*, 38, 11, 1946, p. 1018. *Circ.* 114, Texas Agr. Exp. Sta., 1947.) In experiments conducted at Temple in 1943 and 1944, the seed cottons from live plants and from plants killed by *Phymatotrichum* root rot were picked separately and their fibre and seed properties compared. The 1944 experiments included plots that were irrigated and manured, irrigated, dry and manured, and dry. In the averages of all treatments the following effects of boll immaturity were found: Percentages of lint, mostly unchanged; fibre weight per inch, reduced; percentages of "mature" fibres, reduced; strength of fibres per unit weight of ribbon broken, unchanged; nitrogen concentration in lint, increased; X-ray angles, usually increased; picker and card waste, increased; skein strength of 22s yarn, unchanged; neps in card web, increased; yarn appearance, reduced; oil concentration in seed, reduced; protein concentration in seed, unchanged; grade of seed, reduced; and weight of lint, oil, and protein per seed, reduced.

COTTON IN EGYPT

185. Egypt: Cotton Industry, 1947. (*Overseas Rev.*, Barclays Bank Ltd., December, 1947, p. 13.) There has been a consistent interest in long-stapled Karnak throughout December, and available free supplies, particularly of the lower grades, are getting very short; consequently, prices have been rising steadily. Many countries, including the United Kingdom, France, India, and the United States have been buying. The main movement of the market, however, has been in short staple: Ashmouni has been in demand throughout the season, but there has also been an active enquiry for Zagora, which has made a rapid improvement in price and is now quoted at parity with Ashmouni. Alexandria prices at the beginning of the month were at a favourable parity compared with American cotton, but the sharp rise in prices has now placed Egyptian cotton at a premium over American. France bought important quantities of Ashmouni and Zagora during the month, and the last week the British Board of Trade bought some 40,000 bales of short staples, thereby causing a rise of nearly $2 per kantar in price; further purchases by the Board of Trade are expected by the market.

The Egyptian Government have auctioned some lots of Menoufi, Giza 7 and other special growths, and have now announced their intention of commencing long-awaited auctions of Karnak; for the time being only medium growths are to be sold.

186. Egypt: Cotton Industry, 1948. (*Overseas Rev.*, Barclays Bank Ltd., January, 1948.) Although a satisfactory volume of new export business has been concluded during the month, and enquiries from abroad are still numerous, there is also a considerable speculative stratum running through the market; this has been mainly responsible for the violent fluctuations in price under which gains and losses of as much as 2d. per pound have been recorded in a single day. It appears to be generally realized that Egypt is one of the few countries in a position to satisfy some of the world shortage of cotton, as the export demand has continued throughout the month irrespective of local price fluctuations and despite the present unfavourable parity with American prices of short stapled cotton. Barter arrangements of importance are now under investigation, and in view of the continued shortage in Egypt of many essential materials, such barter deals stand a good chance of success. The Government has used the opportunity of the recent price improvement to sell

small quantities at a time of its holdings. By careful selection of growths and grades not readily obtainable on the market, the auctions have had no reaction on the market, and offers have been readily absorbed at prices satisfactory to the seller, quantities of Menoufi and Giza 7, as well as the highest and low medium grades of Karnak, having been disposed of.

187. COTTON GROWING IN EGYPT. By M. Afzal. (*Ind. Cott. Grwg. Rev.*, 1, 4, 1947, p. 167.) The climatic conditions, irrigation measures, and the development of cotton cultivation in Egypt are briefly discussed. Figures for acreage and yield of Egyptian cotton, acreage under different varieties, and the fibre characteristics of Egyptian varieties, are tabulated. The Egyptian methods of cotton cultivation, agricultural legislation, and seed control organization, are briefly described. The prospects of the introduction of Egyptian cotton in India are considered, and the conclusion is reached that the types will not prove a commercial success in the Punjab.

188. COTTON SPINNING TESTS IN EGYPT. By S. E. Sadek. (*Egyptian Cott. Gaz.*, 2, 1947, p. 60.) An account of the work being carried out at the Spinning Test Mill at Giza, established in 1934, to "find out the value of the different strains of cotton produced by the Botanical Section by testing the strength of the yarn; to protect all long staple commercial varieties from deterioration; to check the quality of the crop by testing cotton samples drawn every year from commercial deliveries." The spinning test report of the Egyptian cotton crop of 1946 is reproduced, and illustrations of the various machines used at the Spinning Test Mill are included.

189. EGYPT: EXPANSION OF INDUSTRY. (*The Ambassador*, December, 1947, p. 138.) The war resulted in a considerable forward movement of industry in Egypt, particularly of those industries producing food and textiles. Recent statistics give 284 establishments, with 85,000 workers and capitalization of £E19 million for the textile industries as a whole. Of these, the cotton industry is the most important. It comprises 347,000 spindles, 11,300 power looms, and 1,850 knitwear and knit fabric machines; production per annum is about 35,000 tons of cotton fabrics, to which must be added some 7,500 tons made on hand looms.

COTTON IN OTHER FOREIGN COUNTRIES

190. AFGHANISTAN: THE TEXTILE INDUSTRY. (*The Ambassador*, January, 1948.) The textile industry of Afghanistan has a capacity for weaving 15 million metres of cloth per annum. Half of this production is by mills, and the remainder by village weaving facilities using yarn manufactured in the mills. Raw cotton for the manufacture of these products is grown in the country. The cloth produced domestically is supplemented by imports. India is the chief source of supply for cotton textiles, but during 1947 an order was placed with the U.S. Commercial Company for 9 million metres of cloth from the American zone of Germany; it was also expected that a further 3 million metres would be obtained from Japan. While Afghanistan grows only enough cotton to meet the needs of its own mills, it produces karakul for export; in fact, this is the chief source of foreign exchange. During 1948, it is reported, Afghanistan will hold three karakul auctions in Europe—possibly in London, in co-operation with the Hudson Bay Company. During 1947 it was proposed that the Government should establish a monopoly for karakul export, while leaving the domestic trade uncontrolled; sales abroad under the monopoly would be in the name of individual dealers, to whom title and profits would accrue. Such a plan comes into operation from March, 1948.

191. ARGENTINE: COTTON INDUSTRY, 1947-48. (*Cott. and Genl. Econ. Rev.*, 16/1/48.) Prospects for the current crop are very poor as only on January 9 did the Chaco get rains of any importance. Quite a number of fields have not been sown, and it is unlikely that the acreage planted is larger than last season. Only within the next few days will it be possible to know how late sowings, which represent 30/40 per cent. of the total acreage, will react. Even if they do germinate the production will

entirely depend on very late frosts. Under normal conditions from now on, it is hardly possible for the crop to reach last year's figure of 72,000 tons.

192. COTTON PROGRESS REPORT. (*Cott. and Genl. Econ. Rev.*, 23/1/48.) A report of January 12 is to the effect that abundant rains have greatly improved the outlook for the cotton crop, and, taking into consideration the larger planted acreage, prospects point to an increase in production on last year's outturn.

193. BELGIUM: GHENT TEXTILE RESEARCH LABORATORY. By D. de Meulemeester and G. Raes. (*Textielwezen*, 3, 9, 1947, p. 99. From *Summ. Curr. Lit.*, xxviii, 2, 1948, p. 51.) There is no textile research institute in Belgium, and the only link between research and the textile industry is the "Laboratorium voor Technologie der Textielstoffen" at the University of Ghent. The equipment of the laboratory and the type of work carried out are described and illustrated. Future prospects are discussed.

194. BELGIAN CONGO: COTTON INDUSTRY, 1946-47. (*Cott. and Genl. Econ. Rev.*, 16/1/48.) The 1946-47 cotton season in the Northern districts was generally favourable, insect damage being less important than in the previous season except in a few areas. Nevertheless, production reached only 57,381 tons of seed cotton, compared with 64,634 tons in the previous season, and 77,325 tons in 1941. This setback was primarily due to: (i) a smaller acreage planted; (ii) inexperienced cultivators; (iii) failure to sow the best land, and incomplete sowings; (iv) abandonment of some late pickings through lack of native incentives.... On the other hand, there was an appreciable improvement in the quality outturn of the crop due to the planting of new varieties (GAR and Stoneville) which are now replacing the Triumph variety which has been grown since 1920.... Preparations for the 1947-48 season have progressed under generally favourable conditions and improved yields are anticipated.

In the Southern districts weather conditions have been generally good throughout the growing season, except in the Kivu region, where torrential rains caused heavy shedding of the bolls. Insect damage has been unimportant except in the Ruiziri zone. In spite of the normal progress of the season, however, purchases of seed cotton to date do not indicate any increase over the 1946-47 production of 58,100 tons of seed cotton. This is due mainly to the exodus of the rural population towards the big towns, which resulted in less cotton being planted and the employment of inexperienced native personnel in cultivation. The Cotton Companies have demonstrated their willingness to assist in any programme to improve the conditions of the rural populations, but the responsibility is mainly on the Government to redress the situation by stabilizing the movement of the population and by providing better medical and social services.

195. BELGIAN CONGO COTTON: PRODUCTION. By V. H. Roggen. (*Textielwezen*, 3, 9, 1947, p. 116. From *Summ. Curr. Lit.*, xxviii, 2, 1948, p. 27. In Flemish.) Statistical evidence is given of the increasing importance to the Belgian economy of the recent rapid development in the cotton production of the Congo, which now supplies 35 per cent. of Belgium's cotton imports. Climate, wood-clearing policy and labour scarcity are preventing increases in acreage, but the Institute for the Agronomic Study in the Belgian Congo has created experimental stations which seek to improve quality and introduce new strains. To date the American "Triumph Big Boll" has been the most successful. Transport difficulties have in the main been responsible for the high prices.

196. BRAZILIAN COTTON: CULTIVATION IN THE CHACO. By C. H. Carbajal. (*Algodon* No. 123-4, 1945, p. 304. From *Summ. Curr. Lit.*, xxvii, 20, 1947, p. 433.) A historical review of the development of cotton cultivation in the region. Contrary to other cotton-producing regions or countries, the price of cotton has little effect on the extension of the industry in the Chaco. This is mainly due to the advantages presented by cotton compared with other crops grown in the region. The Chaco offers an enormous potential cotton-growing area with excellent natural conditions.

197. A NEW COTTON HYBRID FOR CULTIVATION IN PARAIBA. (In Portuguese.

Bol. Minist. Agr., 33, 9, Rio de J., 1944, p. 127. From *Pl. Br. Abs.*, xvii, 4, 1947, p. 461.) By hybridizing the local cotton Moco with fine quality Egyptian cottons Faria has produced superior types with long fibres, one of which bears 72 per cent. of fibres exceeding 34 mm. in length.

198. COTTON CULTIVATION IN SANTE FÉ PROVINCE. By O. C. Larreguy. (*Algodon*, No. 123-4, 1945, p. 281. From *Summ. Curr. Lit.*, xxvii, 20, 1947, p. 433.) A detailed description of the soil and climatic conditions in the Province, and the cultivation of cotton is analysed in relation to the environments described. . . . The choice of the most suitable variety for cultivation is briefly discussed and measures for achieving the best results in cultivation are summarized.

199. BURMA COTTON INDUSTRY. (*Cott. and Genl. Econ. Rev.*, 6/2/48.) Among the early economic goals of the Government will be the restoration of cotton production to the pre-war level of about 100,000 bales annually, and the construction of a Government spinning and weaving factory. Cotton varieties are to be improved.

200. COTTON INDUSTRY, 1947-48. (*Cott. and Genl. Econ. Rev.*, 2/1/48.) The matured area for the 1947-48 crop, according to the third official estimate, is 179,480 acres, which represents only 46 per cent. of the pre-war five years' average matured area. It shows a decrease of 21 per cent. on the 1945-46 matured area, but an increase of 36 per cent. on that of 1946-47. The outturn of the 1947-48 crop is estimated at 7,500 tons (42,000 bales) of lint, of which 6,000 tons (33,000 bales) are likely to be available for export.

201. CHINA. (*Cott. and Genl. Econ. Rev.*, 23/1/48.) Under a 10-year programme of national development drawn up by the National Economic Council, it is planned to increase the installed cotton spindleage in China from the present figure of about 4,000,000 to 12,500,000, expanding substantially domestic raw cotton production over the same period.

202. FRANCE: COTTON SUPPLY POSITION. (*Cott. and Genl. Econ. Rev.*, 20/2/48.) The tight raw cotton supply position has been partially relieved by recent arrivals of Egyptian and East Indian cotton, and it is hoped that further purchases of U.S.A. cotton can be arranged against the interim-aid programme. The longer-term supply prospect, however, is still almost entirely dependent on the quantities to be allocated to France under the Marshall Plan. Meanwhile, the Government has agreed to allow the private import of certain specified commodities, including raw cotton, provided payment is made out of private holdings of foreign currency. It is not thought, however, that much cotton will be imported under these conditions. In view of the present strained national economic situation no early change in the existing system of raw cotton importation through the G.I.R.C. is generally expected.

203. FRENCH COTTON GOODS: EXPORT TO FRENCH COLONIES. By R. A. de la Baumelle. (*L'Indus. Text.*, 64, 1947, p. 140. From *Summ. Curr. Lit.*, xxvii, 24, 1947, p. 585.) In the first part of this article the author shows how important for the French cotton industry are the French colonial markets which, in 1938, absorbed 32½ per cent. of its production, this being equivalent to 43,500 tons, the highest to date of a series of steadily increasing annual export figures. The second part is devoted to a discussion of the present state of affairs—instead of a planned export of 42,000 tons in 1946-47 a bare 18,000 have been exported, with consequent discontent in the colonies—and the causes which brought it about, mainly the disorganization of the industry and needs of the home population. Finally, an attempt is made to draw up a plan to restore the former trade balance, which includes recommendations for the import of better raw materials, reviewing recent price legislation, and better organization of the present systems of distribution.

204. NOTES SUR LES COTONNIERS CULTIVÉS AU SOUDAN FRANÇAIS. By G. Roberty. (*Ann. du Musée Col. de Marseille*, 3, 6, 1945.) These notes, compiled from 1933-39, give an analysis of the successive stages in the improvement of lines, followed by an alphabetical list of common names, an index arranged systematically, and a table of the distribution of the cultivated cottons in French West Africa.

205. GREECE: COTTON INDUSTRY, 1947. (*Cott. and Genl. Econ. Rev.*, 23/1/48.)

Harvesting of the 1947 domestic cotton crop may be considered as ended; quantities remaining in the fields are negligible and of inferior quality. Total production is estimated at about 35,000 tons seed cotton. Ginnings to November 30, 1947, amounted to 4,579,850 kilos, or about 40·7 per cent. of the estimated total outturn. . . . Important purchases of domestic cotton were effected early in November, and in some districts quantities of higher grade cotton were sold above the minimum guaranteed price. Since early December, however, demand has slackened. It is believed that 55 per cent. of the crop is still in producers' hands. . . . Visible stocks of raw cotton in Greece on November 30 last are given as 15,539 tons, of which 14,340 tons are domestic cotton, 400 tons U.S.A., 713 tons Egyptian, and 86 tons East Indian.

206. MOROCCO: COTTON AND OTHER FIBRES. (*L'Indus. Text.*, 63, 1946, p. 217. From *Summ. Curr. Lit.*, xxvii, 22, 1947, p. 509.) A survey is presented of the developments in the production and processing of cotton, wool, animal hair, hemp, sisal, ramie, and other fibres. In spite of the lack of many necessary technical facilities, the textile industries have grown and been able to meet the most urgent demands of home consumption.

207. PERU: COTTON INDUSTRY. (*The Ambassador*, December, 1947, p. 140.) Special measures have been taken by the Peruvian Government to increase the supply of insecticides to cotton cultivators; the severe crop losses as a result of insect ravages in 1946-47 have focused attention upon the matter. The Government, in order to prevent a repetition, has agreed to grant official exchange for 800 tons of calcium arsenate benzene hexachloride mixture, and about 600 tons of calcium arsenate; it is feared, however, that an over-all shortage of dollars may delay the arrival of these quantities in full. The country is also urgently in need of machinery, and it is reported that some 100 tractors for cotton cultivation are already on order; these will not be sufficient for replacements, however, without in any way being able to offset the labour shortage. Cotton producers may be expected to benefit, on the other hand, from the reorganization of the Ministry of Agriculture now under way. . . . Under the new system there will be facilities for operation of more machinery pools; better allocation of insecticides and fertilizers; while the groundwork will be laid for the proposed ten-year agricultural development programme.

SOILS, SOIL EROSION AND FERTILIZERS

208. SOIL REACTION AND AVAILABILITY OF PLANT NUTRIENTS. By H. J. Harper. (*Bull. B*-315, Oklahoma Agr. Exp. Sta., 1947.) This bulletin reports the results of chemical tests of some thousand samples of soil to observe the effect of soil reaction (acidity or alkalinity) on the availability of plant nutrients. Information is also given in connection with the effect of soil acidity on the availability of nitrogen, phosphorus, and sulphur in soil organic matter.

209. SOME ASPECTS OF SOIL CONSERVATION FOR JAMAICA. By W. C. Lester-Smith. (*J. Jamaica Agr. Soc.*) A discussion of the subject under the following headings:—General; Watershed and Catchment Control; Deforestation; Wind Protection; Land Usage; Hillside Erosion; Food Production; Soil Protection and Improvement; Anti-Erosion Measures; The Costs of Anti-Erosion Works.

210. THE CONTROL OF SOIL EROSION. By W. C. Lester-Smith. (*Jour. Jamaica Agr. Soc.*, January-March, 1946.) A report of an address delivered to the Clarendon Branches of the Jamaica Agricultural Society, discussing the causes and effects of soil erosion. The need is stressed for the conservation of the soil by means of reafforestation, the construction of boundary trenches or walls, and the establishment and maintenance of permanent contour strips. The unrestricted burning and clearing of the land should be prohibited.

211. PLANT AND SOIL. (Pubd. Martinus Nijhoff Co., The Hague, Holland. Subscription $7.50 per volume. 400 pages. From *Plant Physiology*, xxii, 4, 1947, p. 644.) The first number of this important new international periodical was

due to be issued at the end of 1947. It is devoted to the study of plant nutrition, plant chemistry, and the related subjects of soil science, soil microbiology, and soil-borne plant diseases. Realizing that the increasing demand for intensive crop production all over the world necessitates a quick exchange of the results of scientific research between the workers in this field, a number of outstanding scientists from different countries have decided to collaborate in establishing this new journal. . . . Original contributions in English, French or German may be sent to the secretary of the Board of Editors, Dr. E. G. Mulder, Agricultural Experiment Station, Eemskanaal ZZ. 1, Groningen, Holland.

212. MICROBIOLOGIE DU SOL; UNE NOUVELLE TECHNIQUE DE MICROSCOPIE DIRECTE. By Y. S. Tchan. (*Ann. Inst. Pasteur*, lxxiii, 7, 1947, p. 695. From *Rev. App. Mycol.*, xxvi, 11, 1947, p. 511.) The following simple method has proved very serviceable in the examination of soil samples. A portion of the soil to be tested is placed in a Petri dish and after incubation at 28° C. the top layer is transferred to a flamed slide, and stained with phenicated erythrosine, which results in good differentiation of bacterial and fungal colonies, including *Actinomycetes*.

213. MEMORANDA ON COLONIAL FERTILIZER EXPERIMENTS: 1. PLANNING AND CONDUCT OF FERTILIZER EXPERIMENTS. By A. B. Stewart. 2. FERTILIZER EXPERIMENTS IN COLONIAL AGRICULTURE. By E. M. Crowther. (*Col. No.* 214, H.M.S.O., 1947, 6d. net. From *W. Ind. Comm. Circ.*, December, 1947, p. 276.) The Colonial Office has issued a white paper containing memoranda that have been prepared to implement a recommendation of the Colonial Advisory Council of Agriculture, Animal Health, and Forestry that in view of the very great importance of increasing the production of crops, especially food crops, "steps should be taken to carry out in colonial territories fertilizer experiments with different crops on all soil types and through the sequence of cropping with the object of obtaining precise information on the response of crops to the different fertilizers and on the economics of application." The two memoranda are purely technical and intended for the guidance of Colonial Agricultural Departments and Research Institutes on the conduct and technique of fertilizer trials. Dr. Stewart deals especially with co-ordinated series of simple experiments in cultivators' fields, designed to see how far general recommendations based on results at a few experimental stations can be applied economically over wide areas. Dr. Crowther deals with some of the problems of design of experiments which arise in new investigations where there is little previous local experience on either the most appropriate technique or the kind of results to be expected.

214. AMMONIA AS A SOURCE OF NITROGEN. By W. B. Andrews *et al.* (*Bull.* 448, Miss. Sta. Coll. Agri. Exp. Sta., 1947.) A progress report on crop response to anhydrous ammonia and aqua ammonia, and on equipment and methods of application. Ammonia is the cheapest form of nitrogen available, and is a good fertilizer if applied properly.

In twelve tests with cotton where ammonia and ammonium nitrate were applied side by side, 62 times, at a depth of 4 in. before planting, ammonium nitrate increased the yield 305 lb. of seed cotton per acre, and ammonia increased the yield 386 lb. per acre. The difference was probably due to the superiority of anhydrous ammonia over ammonium nitrate. The 6 in. depth of application of ammonia increased the yield 424 lb. of seed cotton per acre. In one test where the soil was in such poor physical condition that the ammonia could not be completely sealed at the 4 in. depth, ammonia was inferior to ammonium nitrate; the 6 in. depth of application of ammonia, however, was superior to ammonium nitrate at the 4 in. depth.

In seven tests conducted in co-operation with the Delta Branch Experiment Station, the yield of seed cotton was 2,091 lb. per acre from ammonium nitrate and 2,046 lb. per acre from anhydrous ammonia. These data showed that ammonium nitrate produced slightly more seed cotton than anhydrous ammonia, but the variations in the yield of seed cotton obtained were such as to suggest that there was no difference in the efficiency of these two sources of nitrogen in the tests.

215. Effect of Application of Small Doses of Nitrogen to Cotton. By D. V. Narayanayya. See Abstract 143.

STATISTICAL TREATMENT, CULTIVATION, GINNING, ETC.

216. Statistical Analysis of Biology. By K. Mather. (Interscience Publishers, 215 Fourth Avenue, New York 3. Price $5.00. From *Pl. Physiology*, xxii, 4, 1947, p. 645.) This book is a valuable analytical tool to plant scientists and research workers in general. The author outlines the scope of the various statistical methods and their inter-relationship. Representative analyses and examples in the text show how statistical evaluations are applicable to the data of the biological sciences. The subject matter dealing with such basic principles of statistics as Probability and Significance, Distributions, Tests of Significance, the Inter-relationship of Two Variables, Polynomial and Multiple Regressions, and Correlations is couched in a language readily understood by the non-mathematician. A glossary of terms also facilitates acquaintanceship with the vocabulary and mathematical symbols used in statistics. The volume consists of 13 chapters with an individual list of references for each subject. A set of conversion tables and a general index are also included.

•217. Symposium on Statistical Methods in Plant and Animal Breeding. See Abstract 139.

COTTONSEED AND COTTONSEED OIL

218. Cottonseed: Respiration. By M. L. Karon and A. M. Altschul. (*Pl. Physiol.*, 21, 1946, p. 506. From *Summ. Curr. Lit.*, xxvii, 22, 1947, p. 519.) The respiration quotient of resting cottonseed was unity, indicating that carbohydrate is metabolized in the respiration process. The intensity of respiration (RI) is defined as the average rate over a period exceeding 100 days. The average RI is an exponential function of the moisture content of the seed. The respiration rate of mature seeds of the Delfos variety was higher than that of seeds of the Coker's or Oklahoma Triumph varieties. The exponential-type curves which relate moisture content to RI can be converted into linear curves by applying the equation: $y=ae^{bx}$, where y is the average RI, x the moisture content, and a, e, and b constants. The moisture contents of the samples were 12 to 17 per cent. The values of log RI for Coker's and Oklahoma Triumph can be made to coincide with the line representing values for Delfos samples by shifting them 1 per cent. on the moisture axis.

219. Cottonseed: Respiration, Free Fatty Acid Formation, and Changes in Spectrum of Seed Oil during Storage. By L. Kyame and A. M. Altschul. (*Pl. Physiol.*, 21, 1946, p. 550. From *Summ. Curr. Lit.*, xxvii, 22, 1947, p. 519.) Samples of cottonseed taken at intervals during storage were analysed for content of free fatty acid, and the lipolysis-rate constant was determined in each case. By use of a differential equation the lipolysis constant is converted into a linear function of the moisture content of the seed. The spectrum of solvent extracted oils varied during storage of the seeds. The rate of formation of free fatty acid decreased with length of storage. Delfos seeds showed more vigour with respect to lipolysis and respiration than did Coker's or Oklahoma Triumph varieties.

220. Cottonseed: Respiration and Storage: Effect of Inhibitors. By A. M. Altschul *et al.* (*Pl. Physiol.*, 21, 1946, p. 573. From *Summ. Curr. Lit.*, xxvii, 22, 1947, p. 520.) Treatment of the mature seeds with ammonia inhibited respiration and lipolysis, and reduced the light-absorption of the oil at 360 mμ., whereas similar treatment of immature seeds inhibited respiration, stimulated lipolysis, and increased the light-absorption of the extracted oil at 560 mμ. Nacconol NR and 2^1-methyl-l-maleanil inhibited lipolysis in seeds where the respiration was stimulated. Emulsol-607M or -607, and butylmaleimide did not affect the rate of lipolysis. Most of the deterioration in stored cottonseed is due to enzymes rather than to microbial activity.

221. Georgia: Cotton Seed Treatment. (*59th Ann. Rpt. Ga. Exp. Sta.*, 1946-47.) Fuzzy and machine-delinted (reginned) seed were treated with various dust disinfectants, and the results showed that 5 per cent. Ceresan gave the greatest increase in emergence over the untreated seed. Following closely were du Pont 1451 applied by the slurry method, Mycotox, du Pont 1451 applied as a dust, and Dow 9B. Dow 9B was used alone and in combination with Zerlate, with Spergon, and also matted with a 2½ aqueous solution of methyl cellulose. The best results were obtained with Dow 9B used alone. Mycotox, a trichlorophenyl acetate, was used at two rates—½ gram and 1 gram active chemical per 1,000 gs. seed. The latter gave much better results.

222. Utilisation de la Farine de Graines de Coton dans l'Alimentation Humaine au Congo Belge. By G. Tondeur. (*Bull. Agr. du Congo Belge*, xxxviii, 1, 1947, p. 3.) The use of cottonseed meal to supplement the diet of the natives of the Belgian Congo is viewed as only one aspect of the intelligent exploitation of the full possibilities of the cotton seed, which, though up to the present regarded as a by-product, may become more important as the demand for foodstuffs becomes more acute and cotton faces increased competition from synthetic fibres. The social and economic importance of the problem in the Belgian Congo and the directions in which the diets of various sections of the community might be supplemented, are discussed. Before using cottonseed meal as a foodstuff certain precautions must be taken because of the presence of the toxic substance Gossypol. The composition of the seed and the development of Gossypol in it is discussed at length, together with various procedures for counteracting its toxicity. In the United States the main method adopted at present is that of roasting under certain conditions of humidity to transform Gossypol into d-Gossypol and to reduce toxicity to within tolerable limits. There are certain disadvantages involved in the effects of the heat on the protein content of the seed with this method. The fixation of Gossypol into less toxic compounds has been tried, and also the method of mechanical processing, but the most satisfactory procedure would appear to be to eliminate Gossypol by extracting it by means of organic solvents. The advantages of this method are that it completely prevents toxicity and the inhibitory effects of Gossypol on the digestion of proteins, while, furthermore, it preserves the protein content unchanged and makes the Gossypol itself available for possible commercial purposes. Detailed investigations into the treatment of meals and their nutritive value lead to the following conclusions: The cottonseed meal at present available in the Congo could be included safely in a proportion of up to 12·5 per cent. in foodstuffs of which the cooking could be controlled (in bakeries, hospitals, barracks, and prisons, etc.), or in any foodstuffs which are consumed only occasionally. Better methods of roasting at the oil mills could easily produce a meal which could be used up to 20 per cent. in mixtures of which the consumption need not be controlled at all. Finally, treatment by solvents, whether at the stage of extraction of the oil or subsequently, could produce a meal of high quality, free from flavour and colour. Though this method is largely ruled out in the United States because of the extensive alterations to the existing oil mills which its adoption would necessitate, the different conditions in the Belgian Congo permit of serious consideration of it, and it might well be studied in detail by some Government organization. The method presents great possibilities for use in the production of many other oils as well, and its application might well be facilitated by advances in the field of solvents derived from wood.

MACHINERY

223. Cotton Picker. By R. S. Curley. (Saco-Lowell Shops. From *Text. Tech. Digest*, 4, 8, 1947, p. 310.) On a standard cotton picker having an open beater of the Kirschner type or the like, 2 discs are provided at the ends of the beater of a diameter equal to the working diameter of the beater. These discs prevent the

axial flow of air from the ends of the beater toward the centre. The resulting lap made by the machine is more uniform in weight transversely.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL

224. DDT for Insect Control at Army Installations in the Fourth Service Command. By S. C. Dews and A. W. Morrill, Jnr. (*J. Econ. Ent.*, **39**, 3, 1946, p. 347. From *Rev. App. Ent.*, xxxv, 12, 1947, p. 399.) An account of investigations on the comparative value of DDT and other substances for the control of termites at military installations in the south-eastern United States. Various treatments were tried when replacements were made 14 months after construction at a station in Florida having tar-paper buildings originally resting on untreated wooden supports placed without footings directly in the soil. When uprights and blocks for footings were soaked in a solution of 10 lb. DDT in 25 U.S. gals. diesel oil for 24 hours and the same solution was sprayed into the hole and on the soil as it was added around the upright at 1 U.S. quart per hole of 4 cu. ft., no termites approached the posts in the next sixteen months, there were none in the soil around them at the end of that time and the wood was new in appearance.

225. Normal Offspring Produced by Moribund Aphids Treated with DDT. By F. F. Smith. (*J. Econ. Ent.*, **39**, 3, 1946, p. 383. From *Rev. App. Ent.*, Ser. A xxxv, 12, 1947, p. 400.) In small-scale laboratory experiments to compare the toxicity of DDT in aerosols, emulsions, solutions, suspensions and dusts to *Myzus persicæ*, Sulz., moribund aphids that had dropped from treated foliage, with their bodies shrivelled for lack of food, were found to produce healthy offspring for up to three days, and the latter established normal colonies when transferred to untreated food-plants. The aphids dropped from the foliage at about the same rate after all treatments, but death was most rapid and fewest young were produced after treatment with the aerosols or emulsions; solutions, suspensions and dusts were progressively less effective.

226. The Grasshopper Problem in North America. By Dr. B. P. Uvarov. (*Nature*, 20/12/47, p. 857.) A rapid expansion of unplanned agriculture in the North American continent has created exceptionally favourable conditions for various insect pests and for grasshoppers in particular. An analogous situation is rapidly developing in Australia, and it is only a matter of time before Africa will be faced with similar results of extensive agricultural development. There is in Africa a vast and varied grasshopper fauna, many members of which will undoubtedly develop into dangerous pests as soon as suitable soil conditions and abundant food are provided for them by the clearing of forests and by mechanized agriculture. At present, African development is threatened by locust plagues, which are a serious factor, but a periodical one; grasshopper plagues, although less spectacular than locust invasions, will be much more serious in their aggregate effects because they tend to be perennial, as the example of North America shows. Anti-locust policy in Africa is developing on the lines of prevention, and it became possible to formulate such policy only after some twenty years of international research. It will take a long time to study the possible effects of mechanized agriculture on native grasshoppers, and it is therefore not too early to consider commencing such studies. The alternative is to do nothing until the danger becomes imminent, by which time it may be too late for any measures of prevention, and perennial artificial control will be required. Again, the American example shows that such control is very expensive and only highly remunerative crops can stand the cost. Agricultural development of Africa is now being planned on a vast scale, and it may be wise not to forget possible handicaps.

227. Seasonal Breeding and Migrations of the Desert Locust (*Schistocerca gregaria*, Forskal) in Western and North-western Africa. By U. Donnelly. (*Anti-Locust Memoir* 3. Anti-Locust Res. Centre, London, S.W.7, 1947.) The present work was undertaken to describe the seasonal distribution of breeding and

to find out the major trends in the migrations of the Desert Locust (*Schistocerca gregaria*, Forskal) throughout the West African area, comprising French North Africa, Spanish Morocco, Libya, Rio de Oro, French West Africa, French Equatorial Africa, Gambia, Sierra Leone, Gold Coast, and Nigeria. This area forms only a part of the total distribution area of the Desert Locust, which extends to the Red Sea and into East Africa, and further east across Arabia and Persia to India.

The report is well furnished with 19 maps, and a bibliography of 37 titles is included. A list is also included of published papers and documents from which the records on *Schistocerca* were derived.

228. DRIVING HOPPER-BANDS OF DESERT LOCUST TO THE TRENCHES. By M. Haroon Khan. (*Ind. Frmg.*, vi, 7, 1945, p. 296.) The desert locust *Schistocerca gregaria*, Forsk., breeds permanently in India in desert and semi-desert areas extending over some 500,000 square miles, and since control is carried out mainly by unskilled labour, the hoppers can most effectively be destroyed by means of trenches. The method has hitherto been employed in a haphazard manner, involving waste of time, energy, and money, and a number of improvements have, therefore, been made with a view to considerably increasing its efficiency. Details are given of these improvements, which fall under the following headings: (i) The selection of a site for the digging of a trench; (ii) the manipulation of the control party for the digging of the trench and the encircling of the hopper bands; (iii) the size and type of trench; (iv) the method of driving a band into the trench.

229. LOCUST SPRAYING SUCCESS IN TANGANYIKA. (*Crown Col.*, January, 1948, p. 45.) The locust-spraying operations carried out with an insecticide called D.N.O.C. by six Ansons and a Dakota transport in the Rukwa swamp area of Tanganyika met with complete success. The aircraft, which were based on Abercorn, sprayed an area of 1,400 acres in the Milepa area of Central Rukwa, resulting in 100 per cent. mortality. Earlier operations with Gammexane had produced little result. The spraying was part of a campaign organized by the International Red Locust Control at Abercorn in Northern Rhodesia, to prevent a threatened outbreak of red locusts from their permanent breeding grounds in the Rukwa and Mweru wa Ntipa marshes, which would jeopardize plans for increased food production in Northern Rhodesia and adjoining territories.

230. NATURAL ENEMIES OF SOME ARIZONA COTTON INSECTS. By D. W. Clancy. (*J. Econ. Ent.*, 39, 3, 1946, p. 326. From *Rev. App. Ent.*, xxxv, Ser. A, 12, 1947, p. 396.) Observations on natural enemies of three insects attacking cotton in the Yuma Valley region of Arizona and California were made in 1937. The most injurious cotton pest in this region is *Euschistus impictiventris*, Stal., which migrates from other plants to cotton as the bolls are forming. On July 26, there were on an average nearly two adults per plant in one field in Arizona, and numerous egg-masses, many of which were parasitized by *Telenomus mesillæ*, Ckll., or were being consumed by *Collops marginellus*, Lec. The predator destroyed more than twice as many eggs as the parasite, and the two together eliminated an average of 61·4 per cent. of the eggs present. In laboratory tests in which *C. marginellus* and the predaceous bugs, *Geocoris sonoræensis*, Van D., *Nabis ferus*, L., *Sinea undulata*, Uhl., and *Zelus renardii*, Kol., which are abundant in Arizona cotton fields, were offered eggs and nymphs of *E. impictiventris*, *C. marginellus* did not attack the nymphs and none of the Hemiptera attacked the eggs, though *S. undulata* and *Z. renardii* readily attacked first-stage nymphs provided that they were moving.

Bucculatrix thurberiella, Busck., frequently causes severe damage to cotton foliage in the arid south-west, particularly in late summer. During the first instar while it is mining the leaves the larva is subject to attack by *Closterocerus utahensis*, Cwfd., the female of which paralyses the host and then deposits an egg in its body cavity. Although superparasitism is common, only one parasite develops in each host larva. The life-cycle of *C. utahensis* lasts only 12-15 days during mid-summer. Of 250 larvæ of *Bucculatrix* collected from leaf-miners on cotton between September

21 and October 26, 201 yielded parasites, but it was observed that parasitism did not become effective until late in the season. *Catolaccus aeneoviridis*, Gir., *Spilochalcis side*, Wlk., and undescribed species of *Haltichella* and *Hormius* were reared from cocoons of *Bucculatrix*, total parasitism averaging 24·2 per cent. *Catolaccus* was the most numerous.

231. CONTRIBUTIONS TO KNOWLEDGE OF THE PARASITIC FUNGI OF TURKEY, I. By H. Bremer *et al.* (In Turkish. *Rev. Fac. Sci. Univ. Istanbul.*, Ser. B, xiii, 2, 1947. From *Rev. App. Mycol.*, xxvi, 12, 1947, p. 531.) *Pseudomonas malvacearum* attacks both *Gossypium herbaceum* and *G. hirsutum*, but is not one of the principal causes of injury to the cotton crop.

232. THE PARASITISM OF *Striga hermonthica* BENTH. ON LEGUMINOUS PLANTS. By F. W. Andrews. (*Ann. App. Biol.*, xxxiv, 2, 1947, p. 267.) Pot experiments at the Gezira Research Farm showed that *Striga hermonthica* Benth. is not confined to the Gramineæ but can also parasitize groundnuts, cowpea, dolichos bean and soya bean, causing a loss in yield in all but the last-named. The *Striga* plants developing on the roots of these hosts were small, apparently ill-nourished and did not grow more than 1 cm. above the ground, in contrast to the vigorous, flowering *Striga* plants that develop on sorghum. The greatest reduction in yield in these experiments was in dolichos bean, where the aerial growth was reduced 60 per cent.; no significant reduction in root weight was found in groundnuts, cowpea, or soya bean. The last-named plant appeared to be feebly parasitized by *S. hermonthica*. A reduction in total nodule weight, but not in number of nodules, was obtained in groundnuts and cowpea. Parasitized dolichos bean showed a reduction in both the number of nodules and in nodule dry weight; in groundnuts, the later fruit production was seriously reduced. The use of these leguminous crops to clean *Striga*-infested soil is discussed.

233. THE PARASITISM OF *Striga hermonthica* BENTH. ON SORGHUM SPP. UNDER IRRIGATION. I. PRELIMINARY RESULTS AND THE EFFECT OF HEAVY AND LIGHT IRRIGATION ON *Striga* ATTACK. By F. W. Andrews. (*Ann. App. Biol.*, xxxii, 3, 1945, p. 193.) Investigations were carried out at the Gezira Research Farm in the Anglo-Egyptian Sudan. The greater majority of the seeds of *Striga hermonthica* can only be germinated by excretions from roots of certain plants not all of which can act as hosts for this parasite. Unless it becomes attached to a host plant, the *Striga* seedling dies. The growing of those plants whose roots can stimulate the germination of *Striga* seed but cannot be parasitized by it, may be a means of ridding infested land of this parasite. Green ovaries picked from flowering plants produce viable seeds if left to dry. Sorghum is sown in the field during the rainy season, viz., June to October; the earlier the sowing date within this period the greater is the *Striga* attack. In the field *Striga* seeds are distributed in the soil to a depth of at least 15 in. When *Striga* seeds are evenly distributed through the soil. the number of *Striga* seedlings attached to a sorghum root is proportional to the root's development. Size of sorghum seed has no effect on the root size of a sorghum plant, and consequently no effect on the degree of parasitism. The effect of severe *Striga* attack on the sorghum plant is to produce a reduction of about 60 per cent. in leaf and root weight. No reduction of *Striga* attack is obtained when various micro-elements are coated on sorghum seeds before sowing. Field and laboratory experiments show that light irrigation of the sorghum crop during the normal sowing period increases the *Striga* attack and heavy irrigation decreases it. This result was not obtained in laboratory experiments when sorghum was sown out of season. *Striga* attack is lessened when conditions favouring growth of the sorghum crop are improved.

234. FUNDAMENTAL ASPECTS OF THE PREVENTION OF THE MICROBIOLOGICAL DEGRADATION OF COTTON TEXTILES. By R. G. H. Siu. (*Amer. Dyest. Rptr.*, xxxvi, 12, 1947, p. 320. From *Rev. App. Mycol.*, xxvi, 11, 1947, p. 502.) At the Quartermaster Corps Biological Laboratories, Philadelphia, about 200 out of over 10,000 cultures of micro-organisms isolated from deteriorated cotton fabrics have

been shown to possess cellulolytic properties; it is doubtful, however, whether all are of great importance under field conditions. For instance, there is as yet no available evidence of outdoor activity by *Myrothecium verrucaria*, perhaps the most strongly cellulolytic of all the organisms tested in the laboratory. The moulds predominating in the open include *Memnoniella echinata* and *Chaetomium globosum*. The hyphæ penetrate the fibre wall into the lumen, where they proliferate and digest the fibre outwards, unlike bacteria, which adhere to the outer surface and pit their way inwards. The organisms secrete cellulose-digesting enzymes of two classes, viz., (1) cellulase, converting cellulose into cellobiose, and (2) cellobiase, transforming cellobiose into glucose. There are four general lines of approach to the development of preventive methods, i.e., (i) physical exclusion of the organisms from contact with the cellulose molecule, as illustrated by the resistance of resin-impregnated cloth, (ii) cell toxicants (fungicides), (iii) specific enzyme inhibitors (existing to-day only as a theoretic possibility), and (iv) chemical modification of the cellulose molecules on the surface of the fibres into resistant derivatives, which appears to offer great promise of future exploitation.

235. COTTON BLACKARM DISEASE: OCCURRENCE IN THE SUDAN GEZIRA. By A. S. Boughey. (*Mycol. Papers* No. 21, 1947. From *Summ. Curr. Lit.*, xxviii, 2, 1948, p. 27.) Investigations into the cause of regional and annual outbreaks of blackarm disease in the Sudan Gezira Scheme are described. Both types of outbreak appear to arise from the same cause. Correlations between blackarm incidence and the rainfall of two periods, June and September-October, are demonstrated. The possible factors producing these correlations, also their implications in regard to disease forecasting, control-measure checks, and depressing effects of rainfall on yield, are discussed.

236. THE GENETICS OF BLACKARM RESISTANCE. VI. TRANSFERENCE OF RESISTANCE FROM *Gossypium arboreum* TO *G. barbadense*. By R. L. Knight. (*J. of Genet.*, 48, 3, 1948, p. 359.) A strong, partially dominant gene governing resistance to blackarm disease (*Bact. malvacearum*) has been transferred from *Gossypium arboreum* to *G. barbadense* (Domains Sakel). The new gene, B_4, segregates independently of B_1, B_2 and B_3, and it shows additive effect in conjunction with B_2 and with B_3. Three cytogenetically distinct techniques for transferring genes from Old World diploid to New World allopolyploid cottons are described, and their relative merits discussed.

237. THE DEVELOPMENT OF INTERNAL BOLL DISEASE OF COTTON IN RELATION TO TIME OF INFECTION. By E. O. Pearson. (*Ann. of App. Biol.*, xxxiv, 4, 1947, p. 527.) Inoculations of *Nematospora* spp. into cotton bolls at successive weekly intervals from flowering to maturity show that the symptoms produced are closely dependent upon the stage of development reached by the boll when infected. Details are given of the nature and degree of the staining and of the effects upon weights of seed and lint finally produced. During the first four weeks of life bolls are in the stage of rapid growth and differentiation, and infection is followed by severe disorganization of all boll structures and complete commercial loss. Bolls infected later in life develop typical stained lint, but without general breakdown of other tissues, and the degree of staining diminishes steadily with the age when infected, until, towards maturity, little or no effect is produced. Subsidiary experiments show that inoculations of sterile water can cause death of the seed embryos, presumably by plasmolysis, in bolls up to three weeks of age. The effects upon the seed and consequently upon the lint following death of the embryo caused by such treatment are shown to be similar to those following feeding by uninfected insects of the genus *Dysdercus*, which are the normal vectors of internal boll disease. Staining of the lint by *Nematospora* is due to the post-mortem discoloration of the protoplasm of the lint hair, and its extent consequently varies inversely with the degree of vacuolation, which increases with maturity. The mode of action of the fungus and the evidence suggesting that a toxin is involved are discussed. The bearing of the age-damage relationship on the losses due to internal boll disease

in African cotton-growing countries is considered, and the advantages of promoting a steep flowering curve are emphasized.

238. Cotton Leaf Curl Disease: Occurrence in the Sudan Gezira. By A. S. Boughey. (*Mycol. Papers*, No. 22, 1947. From *Summ. Curr. Lit.*, xxviii, **2**, 1948, p. 28.) Annual fluctuations in the incidence of cotton leaf curl in the Sudan Gezira show a correlation with the amount of rainfall in the previous April-May period. There is some evidence that the correlation is due to the effect of this rainfall on the survival of incompletely removed cotton plants. Regional disease outbreaks have been ascribed also to the presence of an alternative host, and to a "house effect" which is attributed to an increased population of the white-fly vector in the shelter afforded in the lee of house gardens. The disease/rainfall correlation is of interest in permitting a forecast of disease outbreaks, checking the efficacy of control measures, and explaining previous fluctuations in crop yield.

239. Factors Affecting the Development of Mould on Cotton Fabrics and Related Materials. By W. J. Illman and M. W. Weatherburn. (*Amer. Dyest. Rptr.*, xxxvi, **13**, 1947, p. 343. From *Rev. App. Mycol.*, xxvi, **11**, 1947, p. 502.) A study under the auspices of the National Research Council of Canada on the influence of temperature and humidity conditions on mould (including *Memnoniella echinata*, *Stachybotrys atra*, *Metarrhizium glutinosum* and *Chætomium globosum*) growth on various textiles and on packaging, electric insulation, and miscellaneous materials, showed that at 86° F. no development occurred at 60 per cent. relative humidity, scarcely any at 70 per cent., and little at 80, but it increased steadily from 85 to 100 per cent. Growth on cotton duck, both untreated and copper naphthenate-treated, was accelerated by the presence of free water. The removal of constituents of unbleached cotton duck by leaching in water (but not in solvents) reduced the incidence of rot. The addition of certain nutrient solutions, viz., salts, dextrose, and lucerne, separately or combined, to the water-leached fabric, did not promote mould growth to the same extent as did the untreated cotton duck.

240. Immunization of Fabrics from Moths, Rot and Mildew. By S. C. Jones. (*Ind. Text. J.*, lvi, 671, 1946, p. 1021. From *Rev. App. Mycol.*, xxvi, **11**, 1947, p. 503.) The available information concerning the control of rot and mildew (*Metarrhizium* sp. *Chætomonium globosum*, etc.) on fabrics is summarized. Proofing agents that have undergone practical testing for this purpose include the copper and zinc naphthenates, salicylanilide, and a number of phenolic and mercury compounds; notes are given on their performance and any special advantages or drawbacks connected with their use. A list of other preparations still in the laboratory stage of experimentation is also given and methods for the application and testing of fungicides are outlined.

241. La Phyllose provoqué par *Paurocephala gossypii* Russell. By Mme. D. Soyer. (I.N.E.A.C., Ser. Sci. No. 33, 1947. Price: Fr. 50.) In March, 1940, a new disease of cotton was observed in the Ruzizi plain near Lake Kivu. In the same year it was also found at Maniema and Lomami. In 1941, thanks to the preservation at the end of the season of a sample of cotton, the causative agent of the disease was discovered. It proved to be a Psyllid of a new species, *Paurocephala gossypii* Russell. The symptoms of the disease, which has been named Psyllosis, are recorded. The Psyllid has been determined and described by Miss Russell of the Bureau of Entomology and Plant Quarantine (U.S. Dept. of Agriculture) from specimens supplied by the author. A French translation of this description is given.

The biological cycle of the insect has been studied; the average period of incubation of its egg is a week, and the complete cycle from egg to adult takes 26 days. The delay between the first punctures and the appearance of symptoms is variable, 15 days being the shortest period. The principal factors which influence the development of the disease are: (*a*) the age of the cotton; (*b*) the number of Psyllids necessary to produce the disease; (*c*) sunlight.

The methods of control recommended are—dusting or spraying with contact

insecticides. The chief predators of the Psyllid are Coccinellids, Syrphids and Araneids. The course of the disease from the moment of puncture onwards is discussed. A brief study of the anatomy of the mouth parts and the mechanism of puncture is included. Various types of damage are caused: mechanical, physiological (by the abstraction of nutritive substances), and chemical (by the injection of saliva which can contain a virus, toxins, or enzymes).

242. THE GLYCOGEN CONTENT OF *Phymatotrichum* SCLEROTIA. By D. R. Ergle. (*J. Amer. Chem. Soc.*, lxix, 8, 1947, p. 2061. From *Rev. App. Mycol.*, xxvi, 11, 1947, p. 488.) The glycogen detected in a recent chemical study in the sclerotia of soil cultures of *Phymatotrichum omnivorum*, the agent of cotton root rot, at the Texas Agricultural Experiment Station, was shown to occur in two forms, viz., (1) free, readily extractable with hot water, and (2) bound, insoluble in hot water but soluble after treatment with hot 35 per cent. potassium hydroxide. Full details are given of the experimental methods used in isolation and purification. The yield of free glycogen from 30 gm. fresh sclerotia amounted to 1·1 gm. or 10·1 per cent. of the dry weight and that of the bound to 2·9 gm. (26·6 per cent.). No differences were found in the chemical properties of glycogen from the two fractions; particulars are given of those of the bound form.

243. SCLEROTIUM STEM ROT CAUSED BY *Sclerotium rolfsii*. By C. J. Magee. (*Agr. Gaz. N.S. Wales*, lviii, 5, 1947, p. 265. From *Rev. App. Mycol.*, xxvii, 1, 1948, p. 47.) *Sclerotium rolfsii* is becoming increasingly widespread in New South Wales, where it has been recorded on carrot, cauliflower, cotton, cowpea, eggplant, sweet potato, tobacco, tomato, many flowering plants, and apple, citrus and peach stocks, etc. The disease is most troublesome under hot, humid conditions in soils rich in decaying vegetable matter, while the susceptibility of different host plants also appears to be related to the extent to which they shade the soil and so increase local humidity. The fungus is usually introduced into a farm or garden in seedlings, soil, or manure, which should be carefully examined for the presence of sclerotia. . . . All infected plants should be burned, since the fungus develops profusely in compost heaps, with prolific production of sclerotia which may become distributed throughout a garden. Attention to surface drainage, and wider spacing help in minimizing losses on infected land. Soil dressings with sulphate of ammonia (4-5 cwt. per acre) are reported to have reduced losses in some countries.

244. WILT OF COTTON. By A. I. Soloveva and L. V. Polyarkova. (In Russian. Tashkent Agr. Pubg. Dpt., Uzbekistan Soviet Republic, 1940. From *Rev. App. Mycol.*, xxvii, 1, 1948, p. 19.) In this study on cotton wilt (*Verticillium dahliæ*), the authors state that the widespread and increasing occurrence of the disease causes serious damage to the cotton crops of the U.S.S.R., the losses in the non-resistant varieties being as high as 40 to 60 per cent. Examinations showed that *V. dahliæ* inhabits the soil, living on organic matter. Temperatures of–30° and 80°C. did not inactivate the fungus, while growth and germination of the microsclerotia were observed at temperatures ranging from 7° to 32° at 20 per cent. soil humidity, though increased moisture greatly stimulated their growth. *V. dahliæ* attacks 27 different plants in Central Asia; cereals were found to be immune. The transmission of the disease by seeds appeared to be negligible. Investigations during 1933-34 showed that lucerne is an extremely powerful wilt-reducing factor. Cotton grown in fields previously planted with lucerne showed only 6·2, 2·56, and 3 per cent. infection, whereas the controls showed 57·3, 50·6, and 43·8 per cent. respectively. In 1937 the variety 36M2 showed 27·5 per cent. infection after the use of fertilizers compared with 48 per cent. for the control. The varieties Vakkona, 0208, 8797, 0214 and 4268 are resistant.

245. COTTON WILT DISEASE: CONTROL. By J. Guillemat. (*Coton et Fibres Trop.*, 2, 1947, p. 17. From *Summ. Curr. Lit.*, xxvii, 19, 1947, p. 394.) A brief historical survey of observations relating to cotton wilt is given, and host plants for *Fusarium vasinfectum*, and symptoms shown by an attacked cotton plant are considered. Information on the classification, morphology, physiology, and pathogenic action

of *F. vasinfectum* is reviewed. Biological observations, such as the entrance of the parasite into the host plant, the relationship between host and parasite, the dissemination of the parasite, and the influence of the environment on the disease, are surveyed. Means of combating the disease are indicated and results obtained by various workers with resistant varieties are summarized. There are 58 references to the literature.

246. Wilt Resistance in Empire Cotton. By A. L. Smith and W. W. Ballard. See Abs. 177.

247. Relation of Environment to the Incidence of *Fusarium* Wilt of Cotton. By V. H. Young. (*Phytopathology*, xxxvii, 6, 1947, p. 437. From *Rev. App. Mycol.*, xxvi, 12, 1947, p. 543.) No correlation was established in 192 soil samples from 11 areas of Arkansas between the *p*H, ranging from 4·66 to 8·4, and cotton wilt. The disease was severe on potash-deficient soils, which tend to acidity, but the latter did not appear to be the decisive factor. The use of boron-containing soil amendments did not reduce the incidence of infection. Eighteen years' records at the Cotton Branch Experiment Station, Marianna, showed that high rainfall, especially in August, was generally correlated with greater prevalence of wilt, while, conversely, the disease was less prominent in years marked by long dry spells, notably in June and July. Over the five-year period from 1929 to 1933 cotton was planted at fortnightly intervals from April 15 to July 1, resulting in a 35 per cent. average of wilted plants for the former date and 3 per cent. for the latter. High soil moisture during more of the growing season is believed to be mainly responsible for the heavier infection in the earlier sowings.

248. Observations in 1945 and 1946 on the Relationship of Rainfall in Louisiana to the Incidence of Fusarium Wilt of Cotton. By D. C. Neal. (*Phytopatholgy*, xxxvii, 6, 1947, p. 435. From *Rev. App. Mycol.*, xxvi, 12, 1947, p. 543.) The rainfall at Baton Rouge, Louisiana, from May to August, 1945, slightly exceeded the 20-year average, with major departures from the normal in June and August. In 1946 the same average was greatly exceeded, with wide deviations from the normal in May and July and slighter ones in June. In both years maximum temperature ranges of 90° to 97° F. occurred during these months. In 1945 wilt (*Fusarium vasinfectum*) appeared early (June 12) and became progressively more severe as the season advanced, resulting in crop failures in several susceptible cotton varieties. On the contrary, in 1946 the disease was only sporadic before mid-August, even on the more susceptible varieties. The precipitation and bi-weekly wilt infection data indicate that the incidence of the disease is increased by alternating wet and dry spells during the optimum period for infection, June to August, and by rainfall slightly in excess of the 20-year average, whereas heavy rains of lengthy duration at this time are adverse to its development.

GENERAL BOTANY, BREEDING, ETC.

249. Heredity. (*Nature*, 4/10/47.) The first number of this new journal appeared in 1947. It is jointly edited by Dr. C. D. Darlington and Prof. R. A. Fisher, and is published by Messrs. Oliver and Boyd, of London and Edinburgh. Its international nature is emphasized by a board of five collaborating editors, of whom three are from Europe and two from the United States. . . . The first number contains ten articles, covering a wide field in their nature, in their subject-matter, and in the countries from which they originate. . . . From the plant side come two papers: one on the interaction of self-incompatibility genes when, contrary to their usual situation, two are present in the same pollen grain; and one on the theory of breeding plants for increased yield. Two further papers consider the effects of natural selection, in one as exemplified by change with time in frequency of certain chromosome types in *Drosophila*, and in the other by the change with climate in frequency of a gene causing a waxy bloom in *Ricinus*. Finally, there is a statistical discussion

of the measurement and analysis of virulence in bacteria and viruses, as it might be applied to genetical work.

250. ADVANCES IN GENETICS, VOL. I. Edited by M. Demerec. (Academic Press Inc., New York, 10, U.S.A. Price: $7.50. From *The New Phytologist*, **46**, 2, 1947, p. 291.) This is the first of a series of volumes of review articles and critical summaries of outstanding problems in genetics. Volume I comprises ten reviews, ranging in content from academic subjects, such as the genetics of *Paramecium*, to matters of interest mainly in the field of applied science. . . . Among the reviews, the " Types of Polyploids: Their Classification and Significance," by G. L. Stebbins, is a useful analysis of the bases for distinguishing the different kinds of polyploids. The author offers the interesting view that most if not all cases of autopolyploids in nature have resulted from chromosome doubling following upon intervarietal or interspecific hybridization, the polyploid species depending for their new characteristics wholly or in part on an admixture of genes from another species or subspecies. He considers that autopolyploidy by itself rarely produces morphologically distinct species, and that the divergence of an autopolyploid from its diploid ancestor by mutation and other genetic changes, without hybridization, seldom if ever occurs. This means that polyploidy should be induced by plant breeders in conjunction with hybridization and selection. As regards the evolution of the Angiosperms, it implies a reticulate phylogenetic " tree " in all genera with polyploidy. The author suggests that where whole families of flowering plants consist largely of polyploid species, hybridization has occurred between families, but the facts do not appear to justify so improbable an hypothesis. This account of polyploidy should be of great interest to botanists.

The final review is by S. G. Stephens on the " Cytogenetics of Gossypium and the Problem of the Origin of New World Cottons." There is good cytological and genetical evidence in support of the view that New World and Polynesian cottons are allopolyploids from a hybrid or hybrids between Asiatic and American species of *Gossypium*. Hutchinson and Stephens suggest that the Asiatic cottons were carried across the Southern Pacific by an early civilization in prehistoric times and cultivated in America, thus providing an opportunity for hybridization to occur with the native American species. This hypothesis will interest anthropologists, particularly if future genetical research can narrow the field of enquiry by giving more precise information of the species involved in the original hybridization.

251. THE ROLE OF MAJOR GENES IN THE EVOLUTION OF ECONOMIC CHARACTERS. By R. L. Knight. (*J. of Genet.*, **48**, 3, 1948, p. 370.) It is considered that preadaptation is not uncommon in economic characters. Notable examples are the resistance of many wild xerophytic species of *Gossypium* to the rain-borne disease, *Bact. malvacearum*, the resistance of several cottons of non-African origin to the virus disease leaf curl (a disease unknown outside the Sudan and Nigeria), and the marked resistance of certain New World species to the Egyptian and pink bollworms. It is argued that preadaptational characters involving major differences will typically be found to be controlled by one or a few large genes, whereas adaptations which arise in " response " to an existing selection pressure may be controlled either by major or minor genes, or both, according to the strength of the genes available. Preadaptation is thought to have played a major part in the evolution of disease and pest resistance, and to this is attributed the predominance of major gene control in resistance. In this connection a list is given of thirty-three crop plants in which major gene resistance to eighty-four pests and diseases has been demonstrated. Major gene control is shown to be of considerable importance in a large number of economic characters other than disease resistance and a list is given of thirty-eight plants in which 160 economic characters have been found to be wholly or partly under major gene control. Approximately 50 per cent. of these characters are classified as preadaptational. It is suggested that major genes are more common in the control of economic characters than is generally supposed. Control by a single powerful major gene, unaccompanied by minor genes, is unlikely

to be common. Single genes alone rarely give complete expression to a character, so that man's constant selection towards the maximum expression of each economic character will have added a complex of minor and modifying genes to the original strong gene. By their very nature, many valuable crop characters are likely to have complex inheritance, but such "blending" inheritance is not necessarily entirely polygenic. For breeding purposes an attempt should be made to reduce complex characters to their integral components to facilitate genetic analysis.

252. STUDIES IN THE GENETIC CONSISTENCY OF GAORANI 6. By P. D. Gadkari *et al.* See Abs. 144.

253. EXPERIMENTAL METHODS WITH COTTON. III. SULPHURIC ACID TREATMENT OF COTTON SEED, AND ITS EFFECTS ON GERMINATION, DEVELOPMENT AND YIELD. By D. MacDonald, W. L. Fielding, and D. F. Ruston. (*J. Agr. Sci.*, xxxvii, 4, 1947, pp. 291, 297.) For experimental purposes the treatment of cotton seed with sulphuric acid, prior to planting, has always been the custom at Barberton. In view of the doubts about the benefits of this treatment which were expressed by Christidis (1936), experiments were carried out at Barberton in the 1938-39 and 1939-40 seasons, to provide concrete proof, if possible, of the advantages which it was believed resulted from it. A series of stand counts made soon after germination revealed definite benefits with acid treatment, in all experiments in both seasons. The seedlings emerged considerably earlier than those from untreated seeds, and the stands recorded at the final counts revealed a significant advantage for acid-treated seed, throughout the experiments. The second season's experiments gave a greater advantage for acid treating when meteorological conditions were bad than when they were good, but the advantage even with ideal weather was still significant. The benefit of acid treatment was shown to be greater, too, with poor samples of seed than with good, and with the smaller seed rate than with the greater. In the 1938-39 experiment green weight samples were taken at three stages during growth, and flower counts were made daily during the flowering period; the data from both these showed that the initial advantage of acid treatment was continuous throughout growth. The experiments have shown that, for South African conditions, acid treatment of cotton seed has definitely led to increase in yield. This increase was significant over normal, untreated seed, except in one case where significance was only achieved after removal of the water-floating (bad) seed. With bad samples of seed removal of water floaters after acid treatment gave a further significant increase, whilst with the good samples the improvement was strongly suggestive. Advantages to the cotton breeder and experimentalist, in acid treating, are stressed.

IV. A STUDY OF THE EFFECTS OF GAP-FILLING ON THE DEVELOPMENT AND YIELD OF COTTON PLANTS IN POOR STANDS OF HAND PLANTED COTTON. Experience raised doubts as to the usefulness of filling gaps in bad stands of cotton at Barberton, and experiments were conducted in two seasons to measure its effectiveness. The experiments gave clear-cut results. Randomized gaps ranging from 20 to 40 per cent. of the stand were filled and left open for comparison, the filling being done 13 and 19 days after planting. Any reduction in stand, though reducing yield per acre, led to large and significant increases in yield per plant, even when the spacing was 3 by 3 ft. wider than that normally used on the Station. Replanting the gaps in a bad stand did not lead to any increase in yield per acre; there were, in fact, indications that this practice actually reduced yield per acre, the refills preventing plants of the original sowing from benefiting fully from the extra space available to them in a bad stand. The general conclusion is that no useful purpose is served by refilling the gaps in poor stands of cotton with up to 40 per cent. of gaps. The fact that a bad stand cannot be usefully improved by gap-filling emphasizes the importance of obtaining a good initial stand in experimental work with cotton; "eye-judgment" of single plant selections or assessment of yield data from field trials when bad stands have occurred, are difficult and unsatisfactory tasks. (*Cf.* Abs. 466, Vol. XVI, 1939, and 266, Vol. XVII, 1940, of this Review.)

254. Cotton Seeds: Germination and Free Fatty Acid. By C. L. Hoffpauir *et al.* (*Science*, **106**, 1947, p. 344. From *J. Text. Inst.*, xxxix, 1, 1948, A38.) A correlation coefficient of 0·79 has been found between the free fatty acid content of the non-germ end of a hulled cotton seed and that of the germ end. The results obtained from 369 individual cotton seeds are presented in a diagram; 71 per cent. of the seeds contained less than 1 per cent. of free fatty acid and the great majority of these were viable; the fatty acid content of the others ranged from 1 to 30 per cent.; all seeds for which the fatty acid content of the non-germ end was above 5 per cent. were dead.

255. Influence of Grafting upon the Generative Sphere in the Cotton Plant. By A. I. Zurbin. (*C. R. [Doklady] Acad. Sci. U.S.S.R.*, **46**, 1945, p. 375. From *Pl. Br. Abs.*, xvii, 4, 1947, p. 461.) Grafting experiments carried out to study the influence of the stock upon reproduction in the scion, are described. It is reported that different graftings showed differences in the time of inception of flowering, the intensity of flowering, the number of ovaries shed, the development of anthers and ovules, and the number of mature bolls and seeds, and that these differences depended upon the genetical affinities between stock and scion. The time of the first flowers and the rate of blooming and the number of mature bolls showed hastening and increase with greater genetical disparity, while the fertility of anthers and ovules appeared to increase the closer the affinity between stock and scion.

256. Cotton Breeding for Specific Uses. By T. R. Richmond. (*Rayon Text. Mnthly.*, **28**, 1947, p. 373. From *Summ. Curr. Lit.*, xxvii, 19, 1947, p. 393.) The need for research in all phases of the cotton industry is stressed and particularly fundamental research in the genetics and breeding of cotton. Collaboration between the cotton breeder and spinner is urged. The necessity of preserving and maintaining the varietal identity and origin of each cotton bale is emphasized. This, combined with fibre tests to evaluate locational and seasonal differences, should aid merchant and spinner to assemble cotton for particular purposes. Some of the problems involved in a suggested " Tested Variety for Specific End-Use Plan " are discussed.

257. Breeding of High Yielding Jarila Cotton. By T. E. Khadilkar. See Abs. 142.

258. Cotton Plant: Carbohydrate Exchange on Saline Soils. By B. P. Strogonov and L. A. Ostapenko. (*C.r. Acad. Sci. U.S.S.R.*, **54**, 1946, p. 273. From *J. Text. Inst.*, xxxviii, 11, 1947, A476.) Cotton (*G. hirsutum*) was grown on naturally saline soil having three levels of salinity. The leaves were analyzed for monosaccharides, disaccharides, and starch at intervals of growth. Monosaccharides showed insignificant variations, both relative to location in the plant and to the degree of soil salinity. Disaccharides accumulated in the upper leaves from more saline plots, as did starch. Irrespective of the degree of salinity, the disaccharide content of the lower leaves decreased during the course of the plant's development. Similarly, starch decreased in both the top and bottom leaves. Other tests involving girdling and keeping the plants in darkness showed that the starch content of the leaves increased in relation to soil salinity, whereas starch formation showed a considerable drop. Results indicate that saline soils have a negative effect upon starch formation rather than upon starch accumulation, and that the increased starch content of leaves from saline plots is due to impeded removal of metabolites from the leaves. Unpublished data showed there was also an increase in the protein and total nitrogen content of leaves from plants grown on highly saline soils.

259. Variations in Length, Strength, and Fineness of Cotton Fibres from Bolls of Known Flowering Dates, Locks, and Nodes. By N. I. Hancock. (*J. Amer. Soc. Agron.*, **39**, 1947, p. 122. From *Pl. Br. Abs.*, xvii, 4, 1947, p. 461.) Variations in the length, strength and fineness of the cotton fibre were studied in relation to the structural development of the plant during the fruiting period. The

varieties investigated included Stoneville 2, Trice 90-1, and Wilds 1. Sampling methods are discussed in the light of the data obtained.

260. COTTON FIBRE: ELONGATION DURING GROWTH. By K. R. Sen and B. K. Kar. (*J. Sci. Club (Calcutta)*, I, **1**, 1947, p. 19. From *Summ. Curr. Lit.*, xxvii, **24**, 1947, p. 575.) A theory of fibre development inside the boll has been developed on *post-facto* data. It is demonstrated that the elongation does not depend on temperature and, consequently, on photosynthesis. Thus there is no true growth or addition of matter during elongation. The soil conditions do not affect fibre elongation except in so far as they influence the availability of moisture to the cotton plant. Thus, the importance of moisture alone in the process of elongation is established and fibre elongation is only a process of turgid attenuation of the cell. This attenuation is proved indirectly by establishing an inverse proportionality between cell length and diameter from experimental data. There are 23 references to the literature.

261. EFFECT OF IMMATURITY ON THE CHARACTERS OF COTTON FIBRE, YARN, AND SEED. By F. M. Eaton *et al.* See Abs. 272.

262. HYBRID VIGOR IN UPLAND COTTON. By P. H. Kime and R. H. Tilley, (*J. Amer. Soc. Agron.*, **39**, 1947, p. 308. From *Pl. Bre. Abs.*, xvii, **4**, 1947, p. 461.) Literature on hybrid vigour in interspecific and intra-specific crosses is reviewed. Hybrid vigour was studied during a three-year period in crosses between inbred lines selected from the Coker 100, Stoneville, and Deltapine IIA varieties of Upland cotton (*Gossypium hirsutum*); Coker 100 and Stoneville are related cottons. On the basis of a comparison with the parent possessing the higher value for a given character, F_1 hybrid vigour was shown in yield of seed cotton, lint yield, lint index, earliness, and rate of blooming. No heterotic increase was, however, observed in the weight of the plants after harvesting, plant height, seed index (weight of 100 seeds), boll size, and fibre strength and length. It appears that hybrid vigour in Upland cotton is expressed in the characters contributing to greater yield rather than in an increased growth of the plant parts. Both the F_1 and F_2 generations showed considerable hybrid vigour in comparison with the parental mean values, the F_2 showing a decrease in hybrid vigour approaching 50 per cent., when compared with the F_1. In the F_3 generation hybrid vigour showed a still greater reduction. The practical application of these results is discussed.

263. NOTE ON THE DIURNAL FLUCTUATIONS IN WATER CONTENT OF FLOATING LEAF DISKS. By P. E. Weatherley. (*The New Phytologist*, **46**, 2, 1947, p. 276.) Recent attempts have been made in Uganda to follow variations in the water content of leaves of cotton plants growing in the field. The technique involved floating punched leaf disks on water for periods of about 24 hours. The following conclusions are presented: Uptake of water by floating disks occurs along the cut edge and not over the whole surface in contact with the water. The diurnal fluctuations in water content of floating disks can be explained simply in terms of transpiration and absorption.

264. PLOT-SIZE IN YIELD SURVEYS. By V. G. Panse. (*Nature*, 14/6/47, p. 820.) The author has studied the problem of plot-size in yield surveys on cotton, which is sown by a drill in evenly spaced rows in Central India. The results are summarized here, as they provide for the first time information on this question applicable to drill-sown crops.

Plots of three sizes, $\frac{1}{20}$, $\frac{1}{200}$, and $\frac{1}{2000}$ acre, were compared. In crops sown in uniformly spaced rows, plot-size is defined by a specified length of a given number of contiguous rows. The plots in the present experiment were marked according to this definition, and since the actual plot-sizes differed slightly from the standard size owing to small variations in row spacing, the plot-yields were reduced to the standard size before analysis. Two plots of each size, or six plots in all, were laid down at random locations in the field. The experiment was carried out in 26 fields at Indore and in an equal number of fields at Government farms in the Central Provinces. In addition to the yields of the plots, yields of whole fields

were accurately measured at the Government farms; but this was, unfortunately, not possible at Indore. Average yields of seed cotton per acre estimated from the three plot-sizes were:

Plot Size.	*Yield (lb. per acre).* Indore.	Central Provinces.
$\frac{1}{20}$ acre	195·7	322·2
$\frac{1}{200}$ acre	197·0	354·9
$\frac{1}{2000}$ acre	221·3	421·8

There was a gradual increase in yield per acre as the plot-size was decreased in the Central Provinces experiment. At Indore also the yield from the smallest plot was larger than the other two. A comparison between different plot-sizes did not, however, reveal significant differences in yield, though the excess of yield estimated from $\frac{1}{2000}$ acre plots over $\frac{1}{20}$ acre plots in the Central Provinces was almost twice its standard error. The comparison of yields estimated from sample plots with the yield obtained by harvesting the whole fields in the Central Provinces proved more conclusive, as shown below:

Comparison of plots with whole fields.	*Difference in yield (lb. per acre.)*	
$\frac{1}{20}$ acre plot	26·7	26·5
$\frac{1}{200}$ acre plot	59·4	28·1
$\frac{1}{2000}$ acre plot	126·3	57·6

The yield estimated from $\frac{1}{20}$ acre plots agreed quite well with the yield for the whole field, as the difference between the two was no more than its standard error; but the excess of the yield estimated from the other two plots over the yield from the whole field was greater than twice its standard error and clearly significant. With $\frac{1}{2000}$ acre plots, the over-estimation was as high as 42·7 per cent. of true yield. Thus, not only did the smallest plot-size $\frac{1}{2000}$ acre, or 22 sq. ft., give highly biased results, but also there was an indication of bias also with the plot size of $\frac{1}{200}$ acre, or 218 sq. ft., in the Central Provinces experiment. The latter result would seem to show that even plots of 200 sq. ft. cannot always be relied upon to give unbiased estimates of yield. The second conclusion from this experiment is that although small plots, such as those used by English and American workers for sampling drill-sown crops, may not be open to serious objection, for comparative purposes the possibility that yield estimates derived from such plots are seriously biased needs attention.

[*Cf.* Abstr. 267, Vol. XXIII of this Review.]

265. Polyploidy, Induction and Colchicine. By O. B. de Menezes. (In Portuguese. *Bol. Minist. Agr.*, **33**, Rio de J., 1944, p. 1. From *Pl. Br. Abs.*, xvii, **4**, 1947, p. 431.) An illustrated account is given of the induction of polyploidy by means of colchicine, the characteristics of polyploids, and their value in plant breeding.

266. Cotton Plant: Chemical Defoliation. By P. W. Gull and E. W. Dunnam. (*Agr. Chem.*, **2**, 6, 1947, p. 33. From *Summ. Curr. Lit.*, xxvii, **23**, 1947, p. 527.) Defoliation with Aero Defoliant (dusting grade calcium cyanamide) gave good results when less than 40 lb. per acre was used. Higher rates killed the leaves, but left no time for the formation of abscission cells. Under dry conditions even 60-70 lb. per acre failed to defoliate the plants. Defoliation was difficult in very wet and cool seasons. The defoliant was best applied 20 to 25 days after the last bloom to set a boll. Later treatments gave poorer defoliation. Earlier application decreased the oil content of the seed, increased its ammonia and free fatty acid, shortened the fibres, and reduced the fibre yield. Defoliation 20-25 days after cutting speeded up maturity 10-14 days. Early defoliation stopped weevil development.

FIBRES, YARNS, SPINNING, WEAVING, ETC.

267. THE METHODS OF CELLULOSE CHEMISTRY, INCLUDING METHODS FOR THE INVESTIGATION OF SUBSTANCES ASSOCIATED WITH CELLULOSE IN PLANT TISSUES. By C. Dorée. (2nd Edn., Chapman and Hall Ltd., London, 1947. Price: 42s. net. From *Nature*, 4/10/47, p. 450.) The earlier edition of this book published fifteen years ago, has been of great value to all whose interests have been in the field of cellulose chemistry, and in this second edition the reader will find, in addition to the multifarious methods of investigation applicable to cellulose and its derivatives, concise accounts of the methods of attack which have been developed for investigations on lignin, hemi-celluloses and pectic materials. . . . No fundamental changes have been found necessary, but a great deal of new material now finds its place in the book. In Part I methods used in the examination of normal cellulose are collected, including the measurement of physical properties, methods of analysis applicable to cellulose, mercerized cotton, rayons, hydrocelluloses and oxycelluloses. There is a chapter devoted to the investigation of damage in cotton and linen fabrics. The second part is concerned with synthetic derivatives of cellulose, including esters and ethers, and on this topic much new matter has been added in the present edition. The third part deals with the compound celluloses, and in addition to a chapter on the qualitative and quantitative examination of plant tissues there are detailed accounts of procedures for the estimation of cellulose and lignin, and of the standard methods for the estimation of furfural, uronic acid and methoxyl. Chapters are also included on the analysis of wood, and on the chemistry of lignin and the hemi-celluloses. The book is designed for use by the practical worker in the laboratory. It is well illustrated with figures and graphs and is fully documented. Precise and detailed directions are given for all the analytical procedures. The comprehensive author- and subject-indexes facilitate reference, and the book has been excellently produced in a clear type which is a pleasure to read. The author is to be warmly congratulated on the appearance of this second edition of a most useful and valuable work.

268. RAW COTTON: COLOUR CLASSIFICATION. By V. Coen. (*L'Indus. Textile*, **64**, 1947, p. 94. From *Summ. Curr. Lit.*, xxvii, **24**, 1947, p. 570.) The author stresses the value to cotton growers and technologists of a systematic classification of different grades of cotton according to their "colour" or degree of whiteness, the nomenclature used being strictly and logically derived from the system of colorimetric analysis employed. Tables and graphs of results thus obtained by the Bureau of Agricultural Economics of the U.S. Dept. of Agriculture are shown. From the percentage reflection of violet, blue, green, yellow, orange, and red light three mean coefficients are derived, and from them the appropriate "colour."

269. COTTON FIBRE: STAINING TEST FOR MATURITY. By C. F. Goldthwait *et al.* (*Text. World*, **97**, 7, 1947, p. 105 *et seq.* From *J. Text. Inst.*, xxxviii, **11**, 1947, A513.) A particular combination of two dyes of contrasting colour (Geigy Diphenyl Fast Red 5 BL Supra I and Ciba Chlorantine Fast Green BLL), has been found very effective for the identification of thin-walled, or immature, cotton fibres. This differential dyeing demonstrates visually the progressive development of cotton lint on the seed, shows clearly the relative amounts and the locations of thin-walled fibres on seeds, and assists in the selection of fibres from seeds for special studies. Examples of the application of the differential dyeing method in sampling procedures and manufacturing processes are given and a number of coloured illustrations are shown.

270. COTTON FIBRE PROPERTIES AND SPINNING QUALITIES. By P. M. Thomas. (*Text. World*, **97**, 6, 1947, p. 120. From *J. Text. Inst.*, xxxviii, **11**, 1947, A513.) The six essential fibre properties are:—strength, coefficient of length variability, upper-quartile length, fineness, maturity, and grade. It is necessary to know the relation of these properties to manufacturing performance. Tables of U.S. Dept. of Agriculture test results are presented which go far in aiding technicians to accom-

plish this purpose. Details of the short-staple cottons tested and their spinning qualities, and the importance of the six fibre properties to strength of carded yarn, strength of tyre cord, appearance of carded yarn, and to percentages of waste of carded yarn are tabulated, as well as details and spinning qualities of long-staple cottons and the importance of fibre properties to strength of combed yarn, appearance of combed yarn, and to percentages of waste of combed yarn.

271. COTTON FIBRES: SWELLING; MEASUREMENT BY MICROSCOPICAL METHODS. By M. L. Rollins. (*Text. Res. J.*, **17**, 1947, p. 19. From *Summ. Curr. Lit.*, xxvii, **10**, 1947, p. 213.) A survey is presented of the literature on microscopical measurement of swelling in single cotton fibres. The extent of swelling, the pre-treatment of materials, and the statistical evaluation of results are considered. There are twenty-eight references to the literature.

272. COTTON FIBRE, YARN, AND SEED: EFFECT OF IMMATURITY ON CHARACTERS. By F. M. Eaton *et al.* (*J. Amer. Soc. Agron.*, **38**, 1946, p. 1018. From *J. Text. Inst.*, xxxviii, **8**, 1947, A329.) In addition to physical changes due to immaturity, the nitrogen concentration in the lint was increased, the oil concentration in the seed was reduced, and there was a reduction in the weight of lint, oil and protein per seed. The protein concentration in the seed was unchanged.

273. DRYING SEED COTTON. By L. W. Faulkner. (*Cott. Tr. J.*, **27**, 9, 10, 1947. From *Text. Tech. Digest*, **4**, 6, 1947, p. 195.) Seed cotton should be dried at a temperature which will not cause damage but will dry the fibre to 5 per cent. moisture to give the best cleaning results. Raw cotton which has been dried to facilitate cleaning should be humidified to about 8 per cent. moisture by bringing the lint into contact with moist air in the gin.

274. COTTON WAX: SOLVENT EXTRACTION. By J. H. Kettering *et al.* (*Text. Res. J.*, **16**, 1946, p. 627. From *J. Text. Inst.*, xxxviii, **6**, 1947, A262.) Data are presented which show that different solvents extracted widely different amounts of waxy materials from cottons in experiments where the quantity of solvent and sample, rate, and total time of extraction, and other laboratory conditions were constant. The Conrad technique, using either ethyl or isopropyl alcohol, was more efficient than any other technique tried for determining wax in cotton. Several other methods of extraction are more suitable for removing wax from cotton for special uses than for analysis of wax content. There are thirty-one references to the literature.

275. COTTON YARNS: TESTING. Laboratoires de Recherches et d'Expertises pour L'Industrie Textile. (*Textielwezen*, **2**, 1946, pp. 119, 165, 259, 359, 472. In French. From *Summ. Curr. Lit.*, xxvii, **11**, 1947, p. 239.) A comprehensive review of the subject of yarn testing, under the headings: (1) temperature and relative humidity of the testing laboratory; (2) regain of the yarn; (3) the actual count (and its relation to strength); (4) the length of the test specimen between the jaws of the strength tester; (5) number of tests and samples; (6) rate of traverse of lower jaw of the tester; (7) maintenance of the tester; (8) skill of the operator; (9) calculation of mean and irregularity; and (10) use of the counterpoise (if any) on dual range testers.

276. PLASTIC-COATED YARN. (*The Ambassador*, July, 1947, p. 162.) Recent tests of yarn—alone possessing poor resistance to abrasion—revealed no sign of wear after 250,000 double rubs with standard testing equipment when coated with a thin film of Vinylite. . . . By various combinations of yarns, films, and processing methods, by orientation and special treatments, many different types of yarns are obtained—in fact, some totally new yarns have been developed which are soft, flexible, and of excellent "hand." Others are stiff and wiry, but with equal dimensional stability. By a modification of the coating process the surface of yarns may be made smooth or rough at will; non-elastic yarns can be given a degree of elasticity. . . . These plastic-coated yarns possess excellent fabricating qualities; they can be woven, knitted, braided, crocheted, and loomed into a variety of weaves and patterns. They may be expected to find extended uses in wearing apparel, interior decoration and upholstering, and can be used in the production of colourful

handbags, shoes, hats, belts, and accessories. . . . The yarns will also prove valuable in electrical insulation, for efficient and watertight lamp cords, telephone cords, and hearing-aid wire.

277. New Data Concerning Changes Occurring in Physico-Chemical Conditions of Cotton Plant Fibres under Reaction of some Reagents. By P. P. Viktorov. (*J. App. Chem.*, xix, 9, 1946, p. 900. From *Text. Tech. Digest*, iv, 9, 1947, p. 346.) It has been shown that reagents of a mineral nature act in a highly destructive manner on the external fibre envelope and produce chemical changes in the cellulose layer embedded in its thickness. In this case, changes in the physico-chemical condition may be referred to the structure and chemical composition of the fibres. When organic reagents are used, the fibres remain almost unchanged structurally and chemically, although their reactivity is enhanced. The usual methods of investigation having failed to explain this activity, the question requires additional study.

278. Cotton Linters: Ash Content. By J. Gautier. (*Coton et Fibres Trop.*, 2, 1947, p. 34. From *J. Text. Inst.*, xxxviii, 11, 1947, A514.) Tests have been carried out in order to ascertain the variations in ash content of cotton linters as a function of the type of linters and of the output of the gin. Full results are tabulated. It is suggested that when ginning takes place far away from the coast and when only top-grade linters warrant the high transport costs, a superficial ginning which gives the highest output in linters is sufficient.

279. Cotton Materials: Rotting. By W. H. Weston. (*Proc. Conf. Quartermaster Text. Res.*, 1947, p. 29. From *J. Text. Inst.*, xxxviii, 11, 1947, A504.) A general account, illustrated with photographs and photomicrographs, is given of the problems caused by fungal attack on cotton clothing and equipment of U.S. forces in tropical countries during the war, and the methods and results of the work carried out by the Quartermaster Corps to protect these materials. This consisted of the identification of the fungi concerned, in all between five and six thousand cultures having been isolated; their propagation, spreading, and mode of contamination; classification into cellulose- and finish-destroyers; their mode and strength of attack; their control by fungicides, which has led to a study of the action of these chemicals; and the chemical modification, e.g., by acetylation, of the cellulose materials to render them more immune to fungal attack.

280. Cotton Tyre Cords and Fibres: Endurance under Static Tensioning. By E. Karrer *et al.* (*Text. Res. J.*, 17, 1947, p. 314. From *J. Text. Inst.*, xxxviii, 10, 1947, A425.) Measurements of time of endurance of tyre cords under static tensioning have been made on experimental mercerized and unmercerized cotton cords, and on commercial rayon and cotton cords. The curves of the relation between the tensioning load and the logarithm of the time elapsing under tension were plotted from data obtained over a range of tensioning load of from 50-90 per cent. of the previously determined tensile strength of the cords. For cotton and rayon cords the relation between the static tensioning and the logarithm of time up to rupture is inverse with tensioning load. For unmercerized cotton the relation is linear at room temperature and at 276° F. For rayon cord a linear relation was not found at either temperature; a similar non-linear relation was found at elevated temperature for mercerized cotton cord. Fibres from the cotton used to construct the cords and filaments removed from the rayon cords show similar relationships between load and logarithm of time as those found in the cords. The breaking under static tensioning in the single cotton fibre and the rayon filament is a phenomenon of flow of the micro-elements in the fibre. A similar relation exists in the cord, indicating that the rupture of the cord is the flow in the fibres or filaments and not merely one of movement of fibre past fibre. Breaking is the terminal condition of this phenomenon of flow.

281. Cotton Yarn: Tendering in Light; Effect of Dyes. By G. S. Egerton. (*J. Soc. Dyers and Colourists*, 63, 1947, p. 161. From *J. Text. Inst.*, xxxviii, 10, 1947, A424.) A study has been made of the effect of different conditions on the

rate of photochemical degradation of 90's/3 Egyptian (Sakel) yarn, undyed, and dyed with different vat dyes varying greatly in sensitizing action, sunlight and the high pressure mercury vapour lamp being used as light sources. The extent of degradation was measured by rise in fluidity and by fall in tensile strength. The influence of the following variables was examined: pressure, composition and R.H. of the gaseous atmosphere; depth of dyeing; physical state of dye (applied in pigment and dye form); quality of light source. The rate of degradation of dyeings with the strongly sensitizing vat dyes in the yellow and orange shade range is greatly increased by moisture in the air; this also holds for undyed cotton. With inactive vat dyes of the blue and green shade range, however, there is little difference in moist and dry atmospheres, pointing to a protective action of these dyes against photochemical degradation in the presence of moisture. A table is given comparing the rate of degradation of undyed cotton with that of the same cotton dyed with 36 different vat dyes, the samples being exposed to sunlight both in dry and in moisture saturated air. Experimental technique is described in detail.

282. Damaged Cotton: Examination by the Congo Red Test. By A. D. J. Meeuse and F. H. M. A. Klompé. (*Mededeel, Vezelinstituut T.N.O.*, No. 82, 1947. In Dutch. From *J. Text. Inst.*, xxxviii, 11, 1947, A515.) A translation of Miss Clegg's paper (B.C.I.R.A.) is presented and supplemented by a critical review of the method resulting from the experience gained at the Netherlands Government Fibre Research Institute, by a practical operating scheme, and by a table. At the Dutch Institute a series of cotton samples was tendered by various procedures. The test was carried out at room temperature on a common microscopical slide, a high temperature (or prolonged action of the stain) having an equalizing effect on staining, so that no clear images can be obtained through lack of contrast. Before staining, the use of needles for separating the fibres should be avoided since they may cause additional mechanical tendering. The preparations can be preserved in 18 per cent. NaOH for a few days. For permanent mounts commercial water glass is suitable.

283. Textile Fibres: Behaviour with Sulphuric Acid. By R. Haller. (*Textil-Rundschau*, 2, 1947, p. 39. From *J. Text. Inst.*, xxxviii, 11. 1947, A514.) The author has investigated the effect of sulphuric acid (40, 48, 52, 54, and 56° Bé.) on bleached American and raw Egyptian cotton, both on the fibres themselves and on batiste fabrics woven from them. Fibres and fabrics behave similarly; the action of sulphuric acid less than 54° Bé, in the cold, does not cause any noticeable physical or chemical change; the border line appears to lie at 54° Bé, the acid causing marked swelling but no decomposition; at 56° Bé there is rapid decomposition and dissolution of the cotton even in the cold. These effects are more pronounced when carried out at temperatures between 96° and 98°.

284. Textile Fibres: Sorption of Nitrogen and Water Vapour. By J. W. Rowen and R. L. Blaine. (*Ind. Eng. Chem.*, 39, 1947, p. 1659. From *Summ. Curr. Lit.*, xxviii, 2, 1948, p. 35.) Measurements have been made of the adsorption of nitrogen and water vapour on purified cotton, wool, viscose, silk, nylon, and cellulose acetate fibres and titanium dioxide. All the fibres had a relatively low adsorptive capacity for nitrogen as compared with water vapour. The surface areas of the textile fibres were computed by the aid of the theory of multilayer adsorption and found to vary between 0·31 m/gm. for nylon to 0·98 m/gm. for viscose rayon. The values of the free surface energies of adsorption as calculated by the Gibbs adsorption equation were the same for wool, cotton, silk and viscose fibres, but differed for nylon and acetate rayon.

285. Textile Machinery Development and Research. By F. Heywood. (*Fibres*, ix, 2, 1948, p. 44.) In this address to the Lancashire Section of the Textile Institute, the necessity is stressed of looking to electrical measuring instruments, high speed photography, resistance wire strain gauges and the like, for assistance in research on textile machinery. Much was being done in the utilization of new materials such as light alloys and plastics. Power consumption and mechanical

efficiency, and the reduction of noise levels were also receiving attention. Pneumatic suction arrangements were aids to efficiency, and automatic doffing offered means of reducing operative effort and movement.

286. WATER-REPELLENT COTTON FABRICS: PERFORMANCE TESTS. By Genevieve Smith and Helen A. Wellington. (*Rayon Text. Mnthly.*, 28, 1947, p. 332 *et seq.* From *J. Text. Inst.*, xxxviii, 11, 1947, A519.) A systematic study is reported of the performance of 23 cotton fabrics (drills, jeans, herringbone twills, etc.) that had been rendered water-repellent by four different agents. Table I gives the dimensions, weight, construction, strength, abrasion, and shrinkage data; Table II the scheme by which repellency is rated; and II-XIV immersion and spray test ratings. The results are discussed in a general summary.

MISCELLANEOUS

287. SKINNER'S COTTON TRADE DIRECTORY OF THE WORLD, 1947-1948. (Pubd. by Thos. Skinner and Co. (Publishers) Ltd., London, Manchester, Bradford, New York, and Montreal.) This is the twenty-fourth edition of this most valuable publication. The efficient compilation of such a directory, arduous under normal conditions, is infinitely more so under the prevailing unsettled state in many parts of Europe, the Middle East, and Asia. The customary revision of details has, however, been carried out, and since the last edition further information has been obtained covering Czechoslovakia, Egypt, Finland, France, Italy, and Norway. The statistical tables relating to raw cotton, which have proved of interest and value to subscribers, have been further augmented, and any suggestions as to additional figures thought to be of interest will be welcomed. The " Hosiery and Knit Goods " section, which has for many years been a feature of the Directory, has been eliminated from the present edition, and in future will be presented as a separate publication concerned solely with this section of the Textile Industry. The " Trade Marks Section " has been revised and augmented to cover all classes of textiles, and includes a considerably extended list of Canadian and United States Textile Trade Marks and branded goods. The thumb holes, provided for ease of reference, are labelled:—Contents; Index; Advt. Index; General Information; Exporters; Merchants; Spinners; Manufacturers, and Doublers; Directors, etc. (British); Dyers, Finishers: Merchant Converters; Fabrics; Silk and Rayon; British Trade Marks; Canadian Trade Marks; U.S.A. Trade Marks; Mill Supplies. All headings, indices, and explanatory notes are printed in English, French, German, Italian, Spanish, and Portuguese. The Directory is absolutely indispensable to all those concerned in any way with the cotton industry. The price by post, British Isles, £1 10s.; Canada and United States, $7.50 (post and duty free); Elsewhere, £1 10s.

ADDENDA

288. NYASALAND. CROP PROSPECTS 1948. (*Cott. & Genl. Econ. Rev.*, 2/4/48.) The report for February from the Department of Agriculture states that planting in the Southern Province was completed in the Lisungwi and Kambalame areas and the crop had made excellent growth. Increased acreages are reported from all areas, though definite statistics are not yet available. In the Central Province the Dowa crop is in flower, but bollworm is apparently more prevalent than usual. In the Kota Kota lake-shore area the crop is also good, but in the Mwadzama and Kasakula hills it will be much less than last year, due to time devoted to food production.

289. UGANDA. COTTON PROSPECTS 1947-48. (*Cott. & Genl. Econ. Rev.*, 2/4/48.) Weather conditions in February were favourable for picking and marketing. Except in the West Nile and Masaka zones, picking was largely completed and the bulk of the crop has been sold. Despite increased production over estimates in some areas, it is possible that the estimate of 170,000 bales may not be reached, owing to a considerable decrease in the Buganda crop.

290. CHINA. COTTON INDUSTRY. (*Cott. & Genl. Econ. Rev.*, 2/4/48.) The trade is now entirely controlled by the China Textile Control Committee. This body supplies all mills, both private and government, with their requirements of raw cotton, local and imported. Mills spin and weave on behalf of the government on a cost plus basis. . . . During the past six months all purchases of foreign cotton have been made by the Chinese Government Mills (China Textiles Industries Inc.) on behalf of the Control Committee. Due to the shortage of U.S. dollars their efforts have been chiefly looking toward sterling area countries, although 30,000 bales of American/Mexican irrigated and 20,000 bales Brazilians were recently purchased for U.S. dollar reimbursement calling for March/April shipment.

291. EGYPT. COTTON PROSPECTS 1948. (*Cotton*, M/c., 3/4/48.) It is becoming more and more evident that the very bad weather conditions of recent weeks have given the new crop an almost record bad start. The cold winds and heavy rainfall have delayed land preparation and sowing in large tracts of the cotton belt, and where early sowing did take place the damage to germination has been so great that resowing on a very large scale is necessary. Up to the middle of the week, about twenty days later than normal, some cultivators were still hesitating to commence sowing, but fortunately there has been a big improvement in weather conditions during the last three days. Early reports are to the effect that there will be an increase of about 10-15 per cent. in the acreage sown over that of last year.

292. SCIENTIFIC RESEARCH IN INDIA. (*Nature*, 3/4/48, p. 513.) A report has been issued in the "Proceedings of the National Institute of Science of India," of a symposium on the centralization of scientific research in India, held on July 23, 1945, which was opened by the president of the Institute, Mr. D. N. Wadia. Mr. Wadia, after referring to the necessity of taking into account the effect of a central policy on the work of various scientific institutions in India, emphasised the benefits likely to accrue from a central organization for scientific research. Central direction should not involve too much interference or loss of independence in the pursuit of science. Dr. J. A. Dunn supported the liaison and co-ordination of research by a single member and department of a central government as the only course which could be wisely pursued, but he was not in favour of the whole of the country's research being brought under one department. He outlined a scheme for a central council for scientific and industrial research, with provincial and State councils, a committee of central scientific departments, and other boards and committees as required. Dr. A. C. Ukil advocated the co-ordination of researches but without power of interference with the findings of the National Research Council, which should be a supreme central body to organize research throughout the country; no Government department, he said, should be allowed to maintain its separate research section, independent of the guidance of that Council. Prof. J. N. Mukherjee also emphasized that the different units dealing with various aspects of research need not all be under one authority; centralization of scientific research should not mean centralized control under one government department. The autonomy of universities and other non-official institutions should not be circumscribed. Prof. M. N. Saha strongly supported Prof. Hill's scheme, as did Prof. P. C. Mahalanobis, with some warning on the danger of bureaucracy and departmentalism creeping in. He urged that the National Institute should press for the fullest possible association with the work of the proposed department of the learned societies, universities, and scientific institutions. Prof. S. P. Agharkar thought that the real difficulties in India were encountered at the policy-making level. Dr. G. J. Fowler set forth points for and against centralization and urged the need for care lest organization crippled individual initiative. Dr. Nazir Ahmad indicated some practical difficulties, but supported the co-ordination of research so as to avoid overlapping, to accelerate the pace of research and to use and to train talent to the best advantage. Dr. J. N. Roy considered that the National Institute of Sciences should concern itself solely with the availability of adequate funds for scientific research, and that the question of organization was outside

its sphere. A report of the symposium is being sent to all Departments of the Government of India with an expression of opinion from the Fellows of the Institute as to the necessity of there being one Department of the Government of India concerned with the formulation of policy, determination of priority and administration of all funds earmarked for scientific research.

293. COTTON RESEARCH IN INDIA. (*Ind. Tr. Bull.*, III, 12, 1947, p. 7.) The ambition of the early sponsors of the Indian Central Cotton Committee some 25 years ago that Indian growers should concentrate their attention on the improvement of the quality as well as the yield of cotton grown in the country, is in process of being realized. For the first time in the cotton history of the country a type of cotton far superior to the best East African types has been produced. The credit goes to Sind, where the cotton research workers have evolved a promising strain possessing good ginning capacity and fine staple. This strain, known as 41/4, is reported to have a staple length of $1\frac{1}{8}$ inches when saw-ginned and $1\frac{3}{16}$ inches when roller-ginned. The ginning percentage is around 33·5 per cent. and the yield per acre about 1,000 lb. kapas. The cotton is stated to have commanded a high premium of Rs. 550 over the Jarila contract when the latter was standing at Rs. 458. Replicated varietal tests are being carried out, under conditions of early and late sowing, at five centres in the important cotton-growing districts of Sind. Multiplication of the seed is in progress to provide nucleus material for further seed distribution.

294. INDIA. LONG-STAPLE COTTON PRODUCTION. (*Cott. & Genl. Econ. Rev.*, 25/3/48.) India is to make every effort to become self-sufficient in her needs of long-staple cotton. Schemes are being formulated to increase her output for next season without reducing the area under food crops. Indian mills need 800,000 bales of long and medium staples annually, which formerly came from Sind and the Punjab. An increase in the area to cotton of 4,000,000 acres is projected, half of the acreage being devoted to cotton stapling $\frac{7}{8}$ inch and above.

295. INDIAN CENTRAL COTTON COMMITTEE. REPORT OF THE TECHNOLOGICAL LABORATORY, BOMBAY, 1946-47. During the period under review the work of the Technological Laboratory progressed satisfactorily. The total number of samples received for testing was 1,204, compared with 1,249 in the previous season. Brief accounts are given of the work carried out by the Spinning Laboratory, Testing House, Fibre Testing Section, Technological Research, and Ginning Sections. Six hundred and forty-three samples were spun, compared with 556 during 1945-46. Five technological bulletins and papers by various authors, nine technological leaflets, and thirty-nine technological circulars were published during the period under review. In addition, nine articles were submitted for publication in the *Indian Cotton Growing Review.*

296. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS, 1946. D. L. Sen. (*Tech. Bull. Ser. A. No.* 66, 1946, Ind. Cent. Cott. Comm. Received 1948.) The usual agricultural details, grader's report, fibre particulars, spinning tests, and remarks, are given for each of the nineteen cottons tested. Four cottons showed an improvement over last season, twelve gave practically the same result, while four cottons showed a falling-off. Improvement was most marked in Sind-American M4. Little change was shown by Jayawant, Surat 1027ALF, Jarila, Sind Sudhar R.G., Sind Sudhar S.G., Sind N.R., P.A.4F, Mollisoni, Umri Bani, Gaorani 6, Cambodia Co.2, and Koilpatti 1. The three cottons which registered a falling-off in spinning performance were Nandyal 14 and Hagari 1 from the Madras Province, and Gadag 1 from the Bombay Province, the decline being more pronounced for the Madras varieties

Printed in Great Britain by
Billing and Sons Ltd., Guildford and Esher

THE EMPIRE COTTON GROWING REVIEW

VOL. XXV. JULY, 1948 No. 3

POST-WAR CONDITIONS IN THE BRITISH CARIBBEAN COLONIES

BY

SIR GEOFFREY EVANS, C.I.E.

A COLONIAL Office Commission of Enquiry necessitated a visit to the British West Indies lasting from August, 1947, to January, 1948. During these months considerable periods were spent in our two mainland colonies of British Guiana and British Honduras—and many of the islands were also visited for periods of up to a week.

The author had resided in the West Indies, with headquarters in Trinidad, from 1926 to 1938, and it was therefore of particular interest to be able to compare the conditions that obtained in the pre-war period with those that now exist.

This region did not suffer physical damage as the result of the war. The towns and villages are intact and the wastage of human life as the result of enemy action was inconsiderable; nevertheless, the impact of war conditions is very obvious in more ways than one. For example, a quickening of the tempo of life is noticeable, and people on the whole are less parochial in their outlook and are more in touch with world affairs. It must not be forgotten that numbers of young West Indians volunteered for service in the Forces of the Crown—the Royal Air Force perhaps being the chief attraction. These young men and women for the most part were going overseas for the first time in their lives, and during their period of war service visited many strange countries and came into close contact with people of many different races. Their range of vision and their ideas were widened greatly by their experiences, and on their return to their own homes their views have had a leavening effect on the whole mass of public opinion and will inevitably continue to do so. In addition to those who enlisted in the Services, there were the thousands of men of the labouring classes who were engaged in war work not only on the American bases in the Caribbean area but also in the United States itself. With the calling up of so many men to the Colours and the enormous expansion of

industry to meet the needs of the war machine, labour became very short in the States and many hundreds of labourers from the West Indies were recruited for brief periods, more particularly for agricultural work such as the cane, fruit and cotton harvests. These men naturally came back with new ideas. They had received good wages for their work, and the food and living conditions were usually considerably better than they had been accustomed to in their own homes, and on their return they naturally desired to continue the high standard of living they had experienced overseas.

Another cause of social unrest was the opening of the American bases in the West Indies. The Colonies chiefly affected were those selected for the defence measures—namely, British Guiana, Trinidad, St. Lucia, Antigua and Jamaica. The construction of the bases was treated as a matter of great urgency and the American contractors recruited local labour and paid wages which were very high compared with existing local rates. The result was that labourers from the countryside and the plantations flocked to the bases, and agricultural production suffered severely. The sugar and cocoa plantations of Trinidad, for example, were nearly ruined. Production in many cases fell to half the pre-war average, and is only now beginning to get back to normal. The sudden prosperity fostered by the construction of these bases proved to be ephemeral. The average West Indian is a cheerful, light-hearted person and a good spender, but he is not addicted to saving. The high wages received were, in most cases, spent—or dissipated—all too soon, and when on the completion of the works the workman was paid off, he found it difficult to go back to the land with its monotonous routine, far from the glamour of the American camps with their canteens, cinemas and other social diversions. It is taking some time also for the fact to sink in that agricultural industries cannot possibly afford to pay the high wages paid by the Americans for a war-time job. Matters are slowly adjusting themselves, but agricultural wages are now nearly double those of pre-war, as a result of the upheaval, and there is not as yet much sign of any fall.

A factor that has also contributed to the higher wages is the greatly increased cost of living. The cost of living index figure in Colonies such as Trinidad is now considerably above 200. In other words, it is more than twice as much as it was in 1939. The standard of living that has arisen as a result of the American impact is naturally higher than it was before the war, but in addition there has been a shortage of essential goods. In this respect the West Indies differ in no way from many other parts of the world, but in these Colonies, at any rate, the shortages in food ought to be capable of partial solution, and measures have been taken by the Colonial Governments to try and meet the position. In the past too much reliance was always placed on imported food-stuffs,

a fact that was clearly brought out in the Report of the Royal Commission of 1939. The two staple cereals, rice and wheat, were imported from Burma and Canada, respectively; salt fish came from Canada and Newfoundland; milk and dairy products were almost entirely imported from Canada and the U.S.A., together with much of the meat in the form of tinned products or salt meat. The West Indians were consequently in a bad position when, after America declared war, submarine warfare extended to the Caribbean Sea and many cargo ships carrying food and other material to the Islands were sunk. For a few months the food position was very difficult and in several Islands reserves fell to an ominously low level. The result was a campaign to render the Islands more self-supporting. In Barbados, for example, the sugar plantations were required by law to plant one-fifth of their area in food crops, and similar measures were adopted by most of the other governments. At the same time the agricultural departments intensified their campaign to encourage food production by the peasants, and plans were elaborated to this end. Apart from cereals and root crops, encouragement is being given to the livestock industry and dairy products, and grants for experimental work and stock farms were made by the Comptroller of Colonial Development and Welfare.

The average West Indian peasant has never been particularly interested in livestock in the past and has much to learn about their care and management. He does not seem to be cattle-minded to the same degree as the people of East Indian descent. A determined effort is therefore being made to provide instruction in the care and maintenance of livestock and to improve the breed since most of the cattle in this area are of mixed descent. In the mainland colonies the main stock is probably derived from cattle of South European type descended from the stock originally introduced by the Spaniards when they occupied these regions. This foundation stock has become much mixed owing to the introductions of stud bulls of European breeds that have been made over a long number of years in an attempt to achieve improvement. These haphazard efforts have resulted in the mixed herds that are encountered throughout the Colonies with the exception of Jamaica, where cattle raising for beef production has always been a definite industry and where exceptionally favourable conditions are to be found on the high-lying limestone plateaux, with their guinea grass pastures. The so-called "pen keepers" who own these cattle estates have for many years paid considerable care to breeding and have introduced much good blood into the Island.

The output from these ranches suffices to meet much of the demand for Jamaica itself, but the other Colonies are not self-supporting and have to import their beef from abroad. This is costly and the result is that many of the inhabitants cannot afford to buy as much as they

really need if they are to get a balanced diet. Attention has naturally been paid to the possibility of developing the cattle-raising industry of the interior of British Guiana with a view to meeting the demands from the Island Colonies. On the face of it there would appear to be considerable scope, since the savannahs of British Guiana, if we include the Berbice area as well as the Rupununi district, cover about seven or eight thousand square miles. The physical obstacles to development are, however, great, as the areas are remote from the coastal ports and the steers have to be brought down on the hoof along a three hundred mile trail each year. Much of the journey is through forest, where grazing is absent or deficient, with the result that the losses are considerable—about 10 per cent. actually dying on the trail, and the survivors losing 15 per cent. in weight en route. Between three and four thousand cattle make the trail each year and the number could be increased if all available surplus stock could be marshalled and despatched. It is obvious that better methods of transporting beef are necessary and consideration has been given to the practicability of establishing an abattoir on the savannahs, thus avoiding the present unsatisfactory conditions. Even if an abattoir were established, it would still not be possible for British Guiana to meet fully the needs of the Islands. She is not even self-supporting in this respect, and imported beef and pork products to the value of £127,000 last year. The grazing on these savannahs is not rich as the soil is light and gravelly in large portions, and is deficient in minerals—lime and phosphates being noticeably absent. At present the savannahs are unfenced and the cattle in the ranches roam at large and are rounded up only once a year for branding and selecting the animals for despatch down the trail. The cost of importing anything from the coast is prohibitive and, until a road or other means of communication lightens the rates, it will not be possible to import fencing or fertilizers. When this becomes practicable it should be possible considerably to increase the carrying capacity, which at present is calculated at one beast per thirty-five acres.

The Colonial Government is fully alive to these facts and has now started a Stock Farm on the savannahs, which I was able to visit. The area is about fifty square miles, which is about the size of the average ranch in the Northern Savannah. The Southern Savannah in contrast is occupied by one cattle company which controls an area about as big as Yorkshire. The problems that need to be attacked by the Stock Farm are not only the improvement of the breed but equally important the improvement of the pasture. To improve the breed a herd of Zebu cattle is being formed with the object of supplying stud bulls to the local ranchers. These animals are better foragers under tropical conditions and therefore thrive better than European

breeds; it has been proved that a proportion of Zebu blood will in other ways prove advantageous as the progeny are less liable to certain

The improvement of pastures involves such matters as the application of fertilizers, fencing to ensure rotational grazing, and the control of burning. There is also an interesting problem connected with the suspected existence of a minor mineral deficiency, which space does not permit of elaboration.

The fact remains that if British Guiana could double the carrying capacity of her savannahs, and had adequate means of getting the beef to the coast, she would be in a position not only to meet all her own needs, but would have a considerable surplus for export which would be of great value to her sister colonies.

The policy of encouraging dairying is meeting with obvious results. In most of the Islands, Government Stock Farms for the supply of stud bulls of good dairy types have been established, largely by means of Colonial Development and Welfare grants. I visited several of these new Stock Farms and was struck by the enthusiasm of those in charge. The buildings and equipment struck me as being perhaps unnecessarily elaborate and expensive, but that may be is an error on the right side. In one or two cases I am not sure that the site has been very happily selected, but if the work of these stud centres can be put across to the local cow keeper by means of an adequate and efficient extension service, the results are bound to be observed in a few years' time. The need is obvious, for nearly all the Colonies rely almost entirely on imports for their supply of dairy products. In British Honduras, for instance, the value of dairy products introduced is higher than petroleum products imported, although some of the best potential dairy country occurs there. At present the lack of local production may be partly due to the preference that undeniably exists for tinned milk, but other factors are the doubt about the wholesomeness of the local product, which is suspect of being produced under unhygienic conditions, and the irregularity of supply. Once these difficulties and prejudices can be overcome, there should be rapid progress.

Already there are several promising evidences of progress. In British Guiana a large co-operative society has been formed which collects milk from various collecting depots and arranges for pasteurization and issue to the public. A visit was made to one of these depots on the Abary Creek one morning. Here the peasants are mainly East Indians, and the milk was brought in various receptacles by boat or road to the collecting depot, where it is measured and each farmer receives his receipt. There was evidence of considerable enthusiasm.

Elsewhere in the larger islands progress has been made in the establishment of dairies to produce high-grade milk for the supply of the

more prosperous inhabitants who are willing to pay for higher quality. The class of cattle is mostly grade Holstein, pure bred bulls being mainly imported from Canada. These dairies are generally managed in an intelligent and up-to-date manner, and the cows are stall fed with imported grains and fodder grasses. Under these conditions the Holstein has proved a suitable breed, but the opinion has been expressed that for the smaller man one of the Channel Island breeds, and particularly the Jersey, may prove more suitable. The cross-bred progeny is not so large and can more readily adapt itself to the conditions it will meet on the small farm. This cross is said to be particularly suitable where butter is the main product sold.

Rice production has received a stimulus during the war years. The chief colony for this product is British Guiana, where the soils and conditions on the coast are admirable and heavy yields are possible. Most of the production is in the hands of people of East Indian descent, who know the crop well. With the cessation of supplies from Burma a special effort was made to boost production in this Colony, and particular attention was directed to the possibility of mechanizing the cultivation. Extensive areas of land were made available by new works which provided the necessary irrigation and prevented flooding, and much money was spent in the erection of a large central mill and in the purchase of tractor implements and harvesters for the mechanization of both the cultivation and harvesting. At the present time certain difficulties have arisen which will need to be overcome. There is the question of getting enough paddy to keep the new mill in operation for a sufficient period to enable it to pay its way. At present about five thousand acres are grown by government, and it looks as if a greatly increased area will need to be grown direct, since most of the farmers in the neighbourhood are bound by custom or credit to the small local mills, which are admittedly not so efficient. The mechanization of rice has also brought in its problems. For instance, harvesting by one of the big combines is vastly more rapid than if done by hand, but the bags of paddy when they come to store have to be opened out and the contents dried, otherwise it will not store satisfactorily. Another factor is that in cutting the machine only reaps the ears and leaves a lot of straw standing which is difficult to get rid of and hampers the production of a seed bed for the succeeding crop. These and other problems have still to be elucidated, and the economics of the industry have also to be worked out. In the meantime a contract to supply the estimated requirements of the other West Indian Colonies for the next few years has been entered upon, and the British Guiana authorities are doing their utmost to meet their obligations in this respect. It is naturally felt that the enforced absence of rice from the Far East has presented a definite opportunity to secure a firm foothold on the

West Indian market, which is considerable. The present position is one of flux, and enough experience has not been gained to decide on a definite policy with regard to complete mechanization of the industry. The position was brought home to me by an Indian farmer who agreed that he was late with his harvest, when I had pointed out to him that the grain was shedding badly. He explained that last year, with the help of his family and friends, and using bullocks, he had been able to cultivate only five acres. This year he had hired a tractor-plough and seed-drill from the Government Rice Mill Depot and had planted about twenty acres. He had not been able to hire a harvesting machine and there was not sufficient labour to harvest the crop. So it is obvious that the rice industry is still experiencing growing pains. There is, nevertheless, a very definite future for rice growing in this Colony.

The main agricultural industry throughout the West Indies is sugar, and judging by any standards the methods of production will bear comparison with other countries. Those responsible for the industry are wide awake and are fully aware of the necessity for continued improvements in technique. Since my last visit considerable progress in organization has taken place, resources have been pooled, and a West Indies Sugar Association has come into being. One of its actions has been to agree to the centralization of sugar research at the Imperial College of Tropical Agriculture, and to make provision for the necessary staff and laboratories, which, however, had not been started at the time of my visit. The position in the field was not so happy and serious labour strikes were holding up production in several of the factories. This unrest is probably an aftermath of the war period when, as already explained, inflated wages had to be paid to get certain works completed with the least possible delay.

The plight of the cocoa industry in Trinidad was sad to see. The ravages of Witches Broom disease and the low prices of the middle thirties had already caused serious losses before the war, and the shortage of labour during the war completed the débâcle. So far as could be ascertained a fraction only of the estates are still operating and those only on the most suitable cocoa soils. The Tobago estates have fared better, and, together with those that have survived in Trinidad and Grenada, are now making good profits, as the price of cocoa has soared to phenomenal heights. The efforts to find new commercial types resistant to Witches Broom disease have not, so far as could be ascertained, proved very conclusive. On the other hand, the high yielding selections made by the Imperial College in the last fifteen years or so have now proved themselves, and planters, particularly in Tobago and Grenada, are availing themselves of these clones and of the new planting technique. There are signs of some revival of the industry in St. Lucia and Jamaica, stimulated no doubt by the present

prices, and there would also appear to be scope for new planting in British Honduras and British Guiana.

With regard to citrus, the war has resulted in changes in the form of the product exported. Before the war whole fruit or grape fruit quarters canned in syrup were the chief products. Difficulty was experienced in shipping these during the war, whereas the demand for fruit juices was greatly increased. In the Stann Creek valley of British Honduras, the factory was in operation at the time of my visit, and the whole of the magnificent grape fruit that this valley produces was being turned into juice for export. The factory was a hive of industry, with baskets of fruit coming in from the orchards and rows of Carib men squeezing the sliced fruit to extract the juice to the accompaniment of wild barbaric songs. Lack of shipping has prevented the export of fresh fruit, but in Surinam the Dutch were shipping their oranges to Holland, and the Jamaica Producers organization was again trying to ship to England. Nevertheless, the "juicing" of citrus fruit seems likely to continue because tropically grown fruit, though excellent in flavour, is often unsatisfactory in appearance, and a high proportion is not suitable for packing and would therefore be wasted if not turned into juice. The out-turn of the citrus packing sheds in Jamaica, Port of Spain, and Stann Creek now goes to England under contract with the Ministry of Food, in the form of juice, sweetened as a rule. Possibly future demands may be more in the direction of concentrated juices and the special juices required for the health services in the United Kingdom. For this purpose it seems that orange juice is most desired, and certain planters are thus contemplating increased orange planting in the next few years.

At the time of my visit the Sea Island cotton crop was not in bearing and the plants in Antigua and St. Vincent were only half grown. The growers of this product received ample encouragement during the war, when Sea Island cotton was in great demand for various uses by the Services and all the crop was purchased by the Ministry of Supply at a guaranteed price. The market is still guaranteed in this way and prices are still good, but production has gone down steadily in recent years. In Montserrat production dropped by over 50 per cent. in 1946 from that in 1941. The crop is, of course, subject to seasonal fluctuations, owing to the somewhat uncertain rainfall conditions, but in this case the area planted is less by half and the average output of lint per acre has shown progressive decline. The system of cultivation employed in Montserrat, together with the steep nature of the country and the friable volcanic soil, has, over many years, resulted in much erosion and consequent loss of soil. It would appear that the area of land left for cotton cultivation is therefore being reduced year

by year, which makes the prospect of any real recovery in production in the near future problematical. There were also rumours of a steady emigration from this Island, to which the above facts have no doubt contributed.

The problem of soil erosion in these islands is one that needs tackling on a really big scale, and a sustained effort is necessary. The only island visited where real progress has as yet been made appears to be St. Vincent. There, thanks to the efforts of the late Superintendent of Agriculture, who unfortunately has now transferred to other duties, a good deal of work has been finished and the resulting terracing, contour planting, and similar methods are clearly visible from the air and make a most pleasing feature.

In Antigua, cotton growing has made considerable progress during the last ten years, and I was able to visit the new cotton station and spend a most profitable afternoon with J. V. Lochrie and his assistant J. R. Spence, who had received his training at the Imperial College of Tropical Agriculture. This station is well situated and the soil is typical of the area cultivated in cotton in this island. I was glad to note that much of the work was concentrated on cultural methods, as the real problem affecting the future of the Sea Island cotton industry is the yield per acre, which is far too low. Up to the present the grower has relied too much on high prices for his profits and not nearly enough on obtaining higher acre yields. Mr. Lochrie's station is a model, so far as the checking of soil erosion is concerned, and as such provides a shining example for the rest of the West Indies to copy. Experiments with the use of artificial fertilizers, as well as with pen manure, time of application and spacing, are giving valuable results. A combined spacing cultivation and fertilizer experiment gave an average of over 1,000 lb. of seed cotton per acre, in spite of considerable damage from insect attack, and on another area in the south-east of the Island, where similar methods were adopted, an average of 1,400 lb. per acre was obtained. The stage has now been reached when these results need to be applied over a wide area, but the progress in this respect seemed to be disappointing, and the staff for the necessary extension is at present apparently insufficient or unsuitable for the work in hand.

Owing to post-war developments it would appear that the demand for Sea Island cotton remains good, and with the shrinkage in output from Montserrat, which I have indicated, there would be a chance for reasonable expansion in other areas, provided the standards of quality are maintained and the costs of production kept within reasonable limits, so that other products such as long staple Egyptian class cottons may not be substituted by the spinners.

Probably the area that offers the best chance of expansion in the future is the Corozal District of British Honduras. In the north of that

Colony the black soils overlying limestone should grow good cotton, since the climatic conditions seem to be very favourable. Only small experimental plantings have been made by the Department of Agriculture, but the results so far, though not conclusive, hold out definite promise. The position with regard to the incidence of insect pests will need careful watching, however, and a decision will have to be made whether Superfine or M.S.I. is to be grown. In all probability the latter type will be found to yield best, but the matter must be put to careful test before any action towards encouraging planting on a large scale is taken. In any case, the population in this area is small and will need to be increased by immigration before much expansion can be expected.

Another form of agriculture that has experienced many vicissitudes within the last ten years is banana cultivation. Even before the war Panama disease, to which had been added later the injury from Sigatoka or Leaf Spot disease, caused by the fungus *Cercospora musæ*, had resulted in a serious decline in Jamaica from a peak of some twenty-five million bunches a year to about half that amount. With the cessation of shipping facilities during the war the output declined still further in spite of the financial support of the Imperial Government, which continued to buy the crop even though none of it was utilized, in order to keep the industry alive. Now the annual production is some six or seven million bunches and it is hoped that the output may eventually get back to twelve million. It seems doubtful whether this will be the case, in spite of the high prices (which are double those of pre-war) now paid. The control of Sigatoka disease by the use of copper fungicides is effective if properly carried out, but is beyond the means of the peasant, since it involves spraying five or six times a year at stated periods, and can only effectively be carried out on estates where the requisite capital is available for setting up the necessary water supplies, pipes and power sprayers. In the meantime, large areas of former banana land on the flatter districts are now under sugar cane, and much of the land on the steeper slopes and on hillsides has been ruined by soil losses due to erosion, so that even if resistant varieties—and there are some promising ones, including the Lacatan variety—are planted, good crops will never be grown on these areas which have lost so much of their fertile soils. I travelled home in one of the banana boats and watched bananas being loaded into the ship from several ports on the north coast of the Island. The fruit nowadays is all purchased by the Ministry of Food, and all bunches are apparently acceptable. Much of the fruit was short and thin and the proportion of "count" bunches was low. Before the war about half the cargo would never have been accepted for shipment. The best fruit came from the larger plantations, which had installed proper spraying equipment. It

seems, therefore, that bananas to supply the export market will of necessity have to be grown in large units, and that the large unoccupied areas of the two mainland colonies will need to be examined more closely. There would seem to be definite possibilities in this connection.

Tobacco growing has received a decided fillip as the result of war conditions. This refers particularly to the cigar trade, which has made immense strides in Jamaica. It was a heartening sight to be able to visit one of the big cigar factories in this colony, which not only manufactures its own cigars but also grows most of the leaf for " filling " and provides lucrative employment for several thousand people. So far a difficulty has been the supply of wrapper leaf, which requires very special methods of cultivation and conditions. The chief market is the United Kingdom, where Jamaica cigars, helped by dollar restrictions, have largely replaced Havanas, and, owing to improved technique, are likely to retain their hold on the markets.

The population problem has long been the cause of much concern in the West Indian Islands. Many of the Islands are becoming overcrowded and the pressure of population has increased in recent years. Before the war, relief was obtained by the temporary absence of many workers, who departed on contract for harvest operations and for specific constructional works such as the Panama Canal. During the war this sort of employment re-opened for a time when, owing to shortage of labour, many men were admitted into the United States for specific jobs. The work was temporary only and the labourers had to return to their own country after a few months. Nowadays the problem is yearly becoming more acute as the population increases, thanks to the efforts of the medical services and the remarkable results in lowering the death rate by such means as the use of D.D.T. against mosquitoes, and the control of malaria. Emigration to most of the South and Central American Republics is either barred altogether or strictly controlled, and attention has therefore been drawn to the possibility of finding suitable homes for the surplus population in the mainland colonies. British Guiana is as big as the United Kingdom and has a population density of four-and-a-half to the square mile. British Honduras is about the size of Wales and has a density of seven per square mile. The corresponding figure for Barbados, the most densely populated island, is over 1,200 per square mile, and that of Jamaica about three hundred. The filling up of the empty spaces of British Guiana and British Honduras with the overflow from the crowded islands naturally sounds feasible, but before immigration on any large scale is possible it will be necessary to plan for the development of the empty spaces—a matter requiring careful consideration and capital. The times are gone when it was possible to say " Here is an empty space, go in and make your way." The present-day Islander is more

sophisticated and is accustomed to certain social amenities, and wants to be sure that he will get a reasonable living and other facilities before he is likely to leave permanently his homeland.

Over-population has resulted in a tendency to under-employment, and land is so scarce in many of the islands that even if all the estates were to be broken up, there would still not be enough land to go round, and in any case the revenues of Government would suffer severe reduction. Considerable thought has therefore been given in recent years to the possibility of developing industries. With the exception of Trinidad, which has oil, all the Caribbean Colonies are without the natural resources in fuel and minerals for heavy industrial works. There are definite signs of progress in the development of light industries, particularly those connected with agriculture. Thus British Guiana and Jamaica are developing factories for the processing of meat and its products; several factories for the conversion of copra into vegetable oil and fats have been started; match factories using local timber are in operation, and cigarettes locally manufactured are common. Development of small factories for light industry is particularly noticeable along the Eastern Main Road out of Port of Spain, which has changed out of all recognition in recent years, and the suburbs of Jamaica are full of similar enterprises. There is a shortage of man-power in other parts of the world, and it is conceivable that one of these days the powers that be may consider bringing the work to the population instead of *vice versa*. This operation should prove quite feasible for certain types of work, such as the textile industry. But the idea is revolutionary and will take time to put into effect. At present all these islands depend on an agrarian economy—which is now overburdened. Industrialization might be one solution to the problem.

One left the West Indies with regret. The inhabitants retain their many pleasing characters and also their proverbial hospitality. Like the rest of the world they are passing through difficult times, but there is no reason why with proper planning and courage their difficulties should not be overcome just as soon as those elsewhere.

Received May, 1948.

SELECTIVE WEED CONTROL BY CHEMICAL MEANS

BY

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Weed: A herbaceous plant not valued for use or beauty, growing wild and rank and regarded as cumbering the ground or hindering the growth of superior vegetation.
(O.E.D.)

HISTORICAL

ALTHOUGH weeds have been the curse of tillers of the soil since Adam, the traditional principles of ploughing, harrowing, hoeing and hand weeding had until recent years remained virtually unchanged. Weeds might be killed by burying or uprooting, by burning or by spraying with almost any chemical in a sufficiently high concentration, but the same treatment would equally kill the cultivated crops. Cleaning of the ground could, therefore, be effected only when there was no crop or by applying the means of destruction to the weeds alone. Both methods had a profound influence on the economy of crop rotation, necessitating the frequent use of bare fallow or of roots or other widely spaced plants.

The first realization that it might be possible to develop chemical sprays which would kill weeds yet leave crops unharmed came in 1896 when Bonnet, a French grape grower, noticed that the Bordeaux mixture he was applying to his vines as a protection against downy mildew was turning the leaves of yellow charlock black. This was followed by similar observations on the weedkilling properties of the sulphates of ammonia and zinc, iron and other metals. To Rabaté (1911), however, must go the credit for demonstrating the real value of sulphuric acid and its derivatives for weed destruction in cereals on a commercial scale. Nitrogenous fertilizers other than sulphate of ammonia, such as nitrate of soda and calcium cyanamide, were also found to have a suppressive action on certain weeds.

In 1932, Truffaut and Pastac filed a French patent for the use of the yellow dyes, dinitro-ortho-cresol (D.N.O.C.) and dinitro-ortho-phenol (D.N.O.P.), derived from by-products of coal distillation, for the selective control of weeds in cereals and other crops. The sodium salt of D.N.O.C. was subsequently marketed in France and later on a

wide scale in the U.S.A. The ammonium salt is also extensively used.

During the 1930s considerable interest was aroused in the so-called "plant hormones," "growth regulators" or "growth-promoting substances." These terms were originally used to denote naturally occurring chemical compounds fabricated in one part of a plant and translocated through the plant tissues to other parts where they produced their effects, *e.g.* the development of roots or fruit or the bending of stems and leaves. They usually had the property of being effective when present only in minute quantities. Examples of the naturally occurring hormones are auxin *a*, auxin *b* and hetero auxin (β-indolylacetic acid). In 1935 it was discovered by Zimmermann and others that certain synthetic compounds would produce effects indistinguishable from those brought about by the naturally occurring hormones. The synthetic hormones include α-naphthylacetic acid, indolylbutyric acid and β-naphthoxyacetic acid. These at once found a wide variety of commercial applications, notably for the inducing of rooting in cuttings, for the control of pre-harvest drop of fruit and as an aid to fruit-set and seedless fruit production. The discovery that plant hormones could be used for selective weed control was made at Jealott's Hill in 1940 when Slade, Templeman and Sexton found that yellow charlock was killed by an α-naphthylacetic acid spray which left cereal crops unharmed. Subsequent tests showed that 2-methyl 4-chlorophenoxyacetic acid (M.C.P.A.) and 2:4-dichlorophenoxyacetic acid (D.C.P.A.) were still more effective. Owing to wartime secrecy these results were not made public until 1945. Meanwhile, Nutman, Thornton and Quastel in England, and Kraus and Mitchell in America, had also realized that synthetic growth substances might be used as herbicides.

Apart from substances used primarily as fertilizers, the selective weedkillers at present available thus fall into four main groups—sulphuric acid and its derivatives, copper compounds, D.N.O.C. compounds, and phenoxyacetic acid derivatives.

Sulphuric Acid

The selective action of sulphuric acid is mainly due to mechanical differences in the structure and the leaf surfaces of plants. Resistant species have smooth, waxy surfaces, upright leaves and basal growing points protected by leafy shoots, whereas susceptible species are typified by flat leaves lacking waxy surfaces and possessing exposed growing points. The latter type are easily wetted by means of fine sprays which run quickly off the leaves of resistant plants without doing harm. The acid concentration must be sufficiently high to penetrate the cell walls of the wetted surfaces. In practice, a 10 per

cent. solution applied at the rate of 100 gallons per acre has been found adequate to kill a wide variety of annual and biennial weeds, including white and yellow charlock, spurrey, chickweed, speedwell and groundsel, while some perennials such as coltsfoot, thistles and docks receive leaf damage and are severely checked. Wheat, barley, oats and grass species are relatively unharmed, quickly recovering from any initial setback and responding well to reduced competition from pernicious weeds. Onions and leeks, too, are resistant.

Although the cost of the acid is low, its strong corrosive action against skin, clothing and machinery entails the use of special precautions in handling. Its high value lies in the rapidity with which it effects a kill under all weather conditions.

Iron Sulphate

Iron sulphate, a by-product of the iron and steel industry, is used for weedkilling either as a spray in 20-30 per cent. solution at rates of 50-100 gallons per acre or as a dust. The dust is generally less satisfactory except after rain or heavy dew, as sufficient moisture to keep the sulphate in solution is essential. Its action, like that of sulphuric acid, is due to the poisoning of plant cells whose walls are wetted by the solution, but the process is slower, often requiring 3-4 days to take effect. Rain immediately following the application may result in much of the solution being washed away. The spray kills charlock in cereal crops and proves effective against groundsel, dandelion, dock, thistles, coltsfoot and other weeds. It is also useful for the control of mosses in grassland. Iron sulphate is frequently used as an ingredient in lawn sand. Its toxicity appears to be increased by the addition of sulphate of ammonia, which has the extra advantage of acting as a fertilizer.

Sulphate of Ammonia

Although the advantages of sulphate of ammonia as a fertilizer are well known, its value as a selective weedkiller is perhaps less widely appreciated. Top dressings applied to permanent pastures and leys serve not only to promote the growth of young, fresh grass, rich in protein, but also to hold in check undesirable weed species. Regular treatment and judicious grazing combine to effect a steady reduction in the weed flora. At 1-2 cwt. per acre, sulphate of ammonia is also useful for the control of weeds in cereals. Corn buttercup, hoary pepperwort and spotted medick in particular respond well to this treatment.

Copper Compounds

Copper, a heavy metal, kills cells by its direct action on the protoplasm and sprayed tissues rapidly wither away. Since the soil in many parts of the world suffers from a deficiency of this metal, the use of copper solution for weedkilling often fulfils a dual rôle both in promoting crop growth and in eliminating weeds.

Copper sulphate, though more costly weight for weight than iron sulphate, is effective in solutions containing only 3-5 per cent. applied at the rate of 50-100 gallons per acre and has the advantage of quick action, so that rain falling a few hours after spraying does not interfere with the results. Its chief use is for the destruction of yellow charlock (*Brassica arvensis*).

Copper chloride can also be used against yellow charlock, maintaining its effectiveness even when spraying is delayed until the weed is in flower. It is claimed to be effective in concentrations as low as 1-2 per cent., an important consideration when supplies of copper are limited. Provided it is applied early, it is more useful against white charlock (*Raphanus raphanistrum*) than is the sulphate. Until the advent of D.N.O.C. and M.C.P.A. it was the only substance which could be used satisfactorily for the control of weeds in flax and linseed, both of which are rather sensitive to contact sprays.

Copper nitrate is often more toxic to weeds than the chloride and is particularly effective in hot, dry weather. Copper compounds in general are less injurious to clovers than other weedkillers, with the exception of D.N.O.C.

D.N.O.C.

The dinitro-ortho-cresol compounds, chemically closely related to picric acid, are non-corrosive to metals and apparently leave no toxic residues in the soil. They are quickly adsorbed on exposed surfaces and resist washing off by rain. Their action, though highly selective, is slow, being effected by means of a disturbance of the plant's respiratory system rather than by direct poisoning. Under adverse conditions, when the weather is damp and cold and the ground dry, susceptible species may show no evident symptoms of injury but may simply grow more and more slowly, remaining stunted and eventually failing through competition from more vigorous resistant species. One of the main advantages of the D.N.O.C. compounds is that most varieties of clover and lucerne are relatively resistant, except just after seeding.

Dinitro-ortho-cresol itself is not soluble in water, but is available for weed control in a finely ground state which, on dilution, forms a suspension.

Sodium dinitro-ortho-cresylate is the most widely used of the D.N.O.C. compounds. It is a powerful yellow dye which stains the skin. Adequate precautions must be taken to protect personnel using it both for this reason and because it can on occasions cause severe toxic effects if taken internally or absorbed through the skin. In a dry state it is highly inflammable, and for this reason is normally sold either in solution or as a paste. Particular care must be taken not to allow the material to dry out on clothing or in open containers, and all equipment should be thoroughly washed after use. Used in 1 per cent. solution at the rate of 100 gallons per acre, its phytocidal action is considerably increased by the addition of " activators " such as ammonium sulphate or sodium bisulphate. American trials have shown that yields of oats, barley and flax can be much increased by the reduction in weed competition resulting from D.N.O.C. spraying, particularly in hot weather. Onions, too, are resistant. In general, the use of sodium D.N.O.C. is not recommended when the daily maximum temperature is less than 50° F.

Ammonium dinitro-ortho-cresylate, another yellow dye, is a more potent weedkiller and does not require the presence of an activator, but is less soluble than the sodium salt and, therefore, more likely to clog the spraying nozzles. At the rate of 100 gallons per acre, it is effective in concentrations as low as 0·8 per cent. and with a wetting agent is especially valuable for the control of corn poppies (*Papaver rhœas*) and fumitory (*Fumaria officinalis*), two weeds of cereals against which sulphuric acid and copper chloride have little effect.

M.C.P.A. and D.C.P.A.

M.C.P.A., the active constituent of " Agroxone," " Methoxone " and " Verdone " weedkillers, and D.C.P.A. (2,4-D), the active constituent of " Y.F. 1541," etc., differ entirely in their action from all the previously mentioned weedkilling substances in that they are not dependent upon absorption in solution through the leaf surfaces. Their ability to cause slow destruction by root absorption means not only that their efficiency is independent of the weather, but also that weed seeds which have germinated and which have not yet appeared above the surface will be killed too. Thus the possibility of a second crop of weeds coming up later in the season is largely eliminated.

These new hormone weedkillers are non-poisonous and non-inflammable, have no harmful effect on clothing or on machinery and may be used in the form either of sprays or dusts. Very small quantities (often only 1-2 lb. per acre) of the active materials suffice, an important factor in remote districts where transport is limited. Field trials have shown that they can be safely used in cereal crops and grasses, in maize, linseed, strawberries and rhubarb, in tea, coffee and

in paddy rice, but that many other crops are highly susceptible, such as cotton, grape vines, tobacco, sweet potatoes, carrots, onions, peas, beans, cabbages and brassica and leguminous crops generally. Owing to the high potency of even minute quantities of the active material strict precautions must be taken to ensure that sprays and dust do not drift on to susceptible crops in neighbouring fields, and spraying apparatus must be thoroughly washed after use.

The selective action of M.C.P.A., D.C.P.A. and other phenoxyacetic acid derivatives varies slightly from compound to compound. Esters, for example, have been found most effective against plants with woody stems and waxy leaves, while for general purposes the sodium and ammonium salts have proved the most satisfactory. To obtain the best results in any particular case it is as well at this stage to consult the literature or to obtain expert advice. A promising application of hormone weedkillers lies in the control of dandelions, plantains, buttercups, bindweed and creeping thistle, all of which are extremely difficult to remove by other means.

It is interesting to note that a substance similar in action to that of M.C.P.A. and D.C.P.A. is secreted by the roots of couch grass (*Agropyron repens*) to enable it to compete favourably with other plants.

Other Selective Weedkillers

Kerosene oil has been used successfully in the United States for checking dandelions in lawns and for selective weed control in umbelliferous crops such as carrots and parsnips.

Calcium cyanamide is much used on the Continent as a combined fertilizer and weedkiller for cereals and other crops. It is best applied at rates of 1-1½ cwt. per acre, either a week or so before seeding or as a top dressing when the crop is well established and the weeds are still small. Being essentially a nitrogenous fertilizer, applications must be balanced by corresponding dressings of phosphates and potash. When handling cyanamide, it is advisable to oil the hands and arms freely before commencing work and to remove the dust with an oily rag immediately after work and before washing. On no account must cyanamide be allowed to come in contact with cuts or wounds.

Potash fertilizers (kainit and muriate of potash) can also be used for controlling certain weeds in cereals, but except on potash-deficient soils the cost is usually prohibitive.

Weed Control in Cotton

Cotton growers who may have hoped to find in chemical means of weed control an immediate end to their troubles have so far been disappointed. Cotton is highly susceptible not only to all the earlier

types of contact weedkiller but to the more modern M.C.P.A. and D.C.P.A., while the effects of D.N.O.C. are not fully known. In the United States drifting D.C.P.A.-ester spray has been observed to cause damage to growing cotton up to 700 feet away from the point of application, so that unless hormone dusts and sprays are carefully controlled it is inadvisable to use them at all in the vicinity of cotton. In the Sudan, on the other hand, where cotton is grown in an 8-year rotation, there are indications that M.C.P.A. may safely be used for weed control during the 2 years of fallow. This gives sufficient time for any residual effects on the soil to disappear.

For the future, the prospects are difficult to assess. At Jealott's Hill a substance known as isopropyl phenylcarbamate (I.P.P.C.) has shown some promise of selective action very roughly complementary to that of M.C.P.A., destroying grass species while leaving most broad-leaved plants relatively unharmed. This and other compounds are still being studied. A successful weedkiller of this type would be of immense value in the elimination of troublesome grasses not only from cotton but from many of the more important food crops, including most green and root vegetables.

The control of broad-leaved weeds in broad-leaved crops—*e.g.*, that of bindweed (morning glory) in cotton—presents a more difficult problem to which no satisfactory solution has yet been offered.

TABLE OF COMMON WEEDS, SHOWING THEIR DEGREE OF SUSCEPTIBILITY TO SELECTIVE WEEDKILLERS

Botanical Name	*Common Name*	*Sulphuric Acid*	*Copper Compounds*	*D.N.O.C. Compounds*	*M.C.P.A., D.C.P.A.*
Brassica arvensis ..	Yellow Charlock ..	× ×	× ×	× ×	× ×
Capsella bursa pastoris	Shepherd's Purse ..	× ×	×	× ×	× ×
Chenopodium album ..	Fat Hen	× ×	O	× ×	× ×
Chrysanthemum segetum	Corn Marigold ..	×	O	× ×	O
Cirsium arvensis ..	Creeping Thistle ..	×	×	O	× ×
Convolvulus arvensis ..	Bindweed	O	O	×	× ×
Fumaria officinalis ..	Fumitory	O	O	× ×	×
Papaver rhœas ..	Corn Poppy	×	O	× ×	×
Plantago major ..	Plantain	O	O	O	× ×
Ranunculus arvensis ..	Corn Buttercup ..	×	O	×	× ×
Ranunculus repens ..	Creeping Buttercup ..	O	O	×	× ×
Raphanus raphanistrum	Wild Radish .. .. / White Charlock ..	× ×	× ×	× ×	× ×
Stellaria media ..	Chickweed	× ×	O	×	O
Taraxacum officinale ..	Dandelion	O	O	O	× ×
Thlaspi arvense ..	Pennycress	× ×	× ×	× ×	× ×
Tussilago farfara ..	Coltsfoot	×	O	O	O

× × Susceptible. × Moderately susceptible. O Resistant.

Received May, 1948.

NEPPINESS AND IMMATURITY IN COTTON

BY

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INCREASED interest has lately been shown in the hardy perennial question of neppiness, particularly in relation to some of the Empire cotton crops. This article has been written in response to a number of enquiries to provide a review of the present knowledge of the nature and cause of neppiness. The use of mature cotton in preference to immature material generally leads to reduced neppiness trouble. Hitherto most cotton workers have accepted immaturity in raw cotton as almost inevitable, considering it to be primarily caused by environmental factors peculiar to the place of growth. Although the cause of fibre immaturity may frequently be physiological, it is shown in this article that varietal effects may also be of marked importance. The magnitude of the genetic effects is sufficiently large to warrant the supposition that in many cases neppiness trouble could be effectively reduced by breeding cottons of increased secondary thickening.

In the cotton trade the term " neppiness " is used in a number of different senses, frequently to describe a speckled appearance of yarn or cloth. Specks on a fine undyed fabric such as muslin are often objectionable and spoil a level or translucent appearance. The trouble is encountered still more frequently in dyed fabrics, in which surface specks show up different in shade from the bulk of the material.

It is not usual to apply the term " nep " to a surface speck free from entangled fibres, but for completeness brief mention of these will be made. The term " shell " is applied to specks of broken fragments of seed completely destitute of fibres. They may arise from the cutting or crushing of normal seeds in ginning, or from the disintegration in the various mill cleaning processes of seeds which the gin has failed to remove. Another type of speck in this class is that known as " leaf," consisting of particles of broken leaf, stalk, bract or other dried plant tissue.

It is not unduly difficult to remove a large proportion of shell and leaf in the cleaning and combing processes or from cloth by brushing, cropping, scouring and bleaching. Nevertheless, removal of increasing amounts of foreign matter steadily adds to processing costs. It is for this reason that when the grade of raw cotton is determined largely

by trash content, the price per pound falls appreciably with falling grade.

An additional disadvantage arising from the incidence of shell or leaf is the "bleeding" of the colouring matter by alkali treatment, which may lead to a spotty appearance in lightly prepared cloths such as mineral khakis.

Another type of speck or nep which appears in yarns or undyed cloths is the "fuzzy mote," a piece of seed coat with fuzz fibres attached. These motes may come from small, undeveloped seeds, which may pass either whole or broken through the gin and become disintegrated in carding, or from broken mature seeds. A piece of seed coat with lint fibres still attached is known as a "bearded mote." Both of these types of motes become closely entangled in the lint cotton, and, when present in excessive quantity, complete removal is difficult. Where they arise from normal fuzzy-seeded cotton the cause may be faulty ginning. In the case of fuzzy motes from undeveloped seeds, the occurrence of an undue high proportion may be caused by environmental factors, but also appears to be of a genetic nature. Some varieties are more prone to produce undeveloped seeds than others grown under similar conditions. Certainly, available evidence suggests that cotton breeders cannot wholly overlook this problem in developing new strains without risking the possible production of a variety which gives trouble to the spinner.

In finished cloths most complaints regarding specks are those caused by cotton neps composed wholly of balls of entangled fibres. It has been found useful to distinguish the following five main types.

(i). A "Process nep" consists of a tangle of normal* fibres or of fibres of the same average maturity as the main bulk. These neps are mainly caused by faulty processing (frequently bad carding) of a cotton which, if properly processed, would not give rise to trouble.

(ii). A "Fuzz nep" consists of a tuft of short fuzz fibres. In finished cloths many of these neps originate from fuzzy motes from which the seed-coat has been removed in the finishing processes. Some, however, are probably caused by the removal of tufts of fuzz fibres in ginning, and the short length of these fibres prevents satisfactory drafting and separation in spinning. This fault is not peculiar to cottons with fuzzy-coated seeds. It has been noted in closely woven cloths spun from Egyptian-type cottons in which the small fuzzy tips have disintegrated to cause the trouble.

* Examination of cotton neps is made by mounting in 18 per cent. caustic soda solution and then viewing under the microscope. The lint fibres are classified on the same basis as in the immaturity test, into "normal," "thin-walled" and "dead" types, and are distinguished from fuzz fibres and foreign fibres such as jute, sisal, etc.

(iii). A "Mixed nep" is one which consists of a tangle of normal and immature fibres gathered round a nucleus such as a fuzz or coarse fibre, or about a piece of foreign fibre accidentally present.

(iv). "Immature neps" are caused by the tangling of the weaker, poorly developed and less rigid fibres with each other, and with normal fibres, in processing. This type is often found in yarns and cloths prepared from cottons containing an excessive proportion of dead or thin-walled fibres.

(v). The "Homogeneous Dead nep" consists of a small close tangle of dead fibres, all with little or no secondary thickening. Like the above class, it frequently occurs when a cotton is immature.

In the experience of the Institute neps due to immature or dead cotton (types iv and v) occur most frequently in the examination of cloths against which complaint is raised on grounds of neppy appearance, and it is with these types that the remainder of this article will be concerned.

Immature and dead neps generally show up as light or white specks in a dyed fabric. There is no way of completely removing them during finishing because they are usually firmly anchored in the yarn by protruding fibres, nor is it possible to modify them by chemical treatment so that they behave in the same way as normal cotton. Mercerizing sometimes produces an improvement, but in any case this process is costly and completely alters the finished appearance of the material. The prominence of neps depends largely upon their size and on the type of dye. In yellow dyes, and generally in pastel shades, the neps are not contrasted so markedly against the background colour as in some reds and blues.

The practice of using a dye which covers the fibres, rather than penetrates them, is one which is sometimes successful. It is, however, only partly successful, because not all dyes are fast, and the range of satisfactory colours is limited. Even if neps are successfully covered with a dye they frequently appear as glazed specks after calendering, and the optical effect is as pronounced as if the neps had not been covered.

Trouble is most pronounced in an immature cotton containing a high proportion of dead fibres. General experience indicates that complaints of neppiness rarely arise when the proportion of dead fibres in the cotton does not exceed about 10 per cent. If the proportion of dead fibres exceeds about 20-25 per cent. many cottons give excessive nep. The result for the intermediate region, with about 10-20 per cent. dead fibres, is uncertain and largely dependent on unknown factors.

Some years ago an examination of a wide range of yarns spun from

different cottons was made at the Institute. The evidence showed that neppy yarns originated mainly, although not invariably, from immature cotton. Later a comprehensive collection of samples was exhaustively investigated. The collection comprised about forty different cottons spun into yarns of the same count and twist, woven into cloth in a weft-faced eight-shaft sateen with the same warp, and dyed in Chlorazol Fast Red K (a penetrating dye giving great prominence to the neps) and vat Indigo. Fibre tests (length, fineness and maturity) were made on the cottons, the cloths and yarns were visually ranked for neppiness and more objective ranking was attempted by nep counts. "Neps" were also examined under the microscope after swelling in caustic soda solution and classified to determine to what extent the specky appearance was due to immature or dead neps. A statistical analysis of the data yielded a number of interesting results.

The several attempts at visual rankings of cloth neppiness by different observers correlated fairly well. Nep counts generally confirmed visual rankings, but do not appear superior for use in such studies. In some instances nep counts and the accompanying microscopical examination suggested that visual ranking is not solely determined by the absolute frequency of immature nep. Size of nep also plays a part.

There was a marked difference in neppiness order between the red and the blue series of cloths, and this difference was found to be strongly related to the fineness of the cotton. The finer cottons looked neppier than the coarser cottons of similar immaturity in blue cloths, and less neppy in red. In both series, however, increased cloth neppiness was found associated with immaturity.

Yarn neppiness was found to be correlated moderately well with the neppiness of the blue cloths, but for the red cloths the correlation was not significant.

The interaction of maturity and fineness noted in this investigation is one which previously had not been given close attention, because it generally enters little into practical problems. One does not usually meet the necessity to rank in a common order of neppiness (say) Sea Island and Indian cottons in similar yarn counts and fabrics. The common problem is to rank cottons of more or less similar fineness and varying maturity.

In some cases immature cottons have yielded cloth comparatively free from nep, or at least from the appearance of nep. A Sea Island cotton with an immaturity count of N-D=50-26 came first in order in the series of red cloths and eighteenth in the blue series. Close examination showed many neps in both cloths, but these did not show in the red cloth because of their small size and because of the lack of contrast

with the general level of shade. In the blue cloth the neps showed up in greater contrast with the background colour.

Deserving of more serious consideration are cases where marked neppiness has developed without warning from the fibre tests. One example of this occurred in the above series, a Texas cotton with an immaturity count of N-D=64-8. Examination of the cotton showed signs of biological attack, causing sporadic occurrence of tufts of dead cotton which apparently can produce nep as effectively as general immaturity.

In other investigations it has been found that, other fibre characters being similar, there is a tendency for cottons of longer effective length to be more prone to neppiness than those of shorter staple.

The question which a grower may reasonably put is, "Can the inherent tendency of a cotton to form nep be greatly influenced by the method of processing?" It is, of course, well recognized that much nep may be removed by combing. On the other hand, combing is used only in the production of the better qualities of yarn, more particularly in the Egyptian and Sea Island trade. Most cottons are carded only because combing is not practicable if the staple is very short, and in any case is costly because of materially increased costs of processing and the loss of cotton removed as waste. In other words, combing is not a general solution for nep removal, since it cannot be economically applied.

The card is the other machine which comes to mind when considering alleviation of neppiness trouble, but its action is somewhat enigmatical, since it both removes and manufactures nep. Close attention paid to the settings of the taker-in, cylinder, flats and doffer, to speeds, choking of cylinder by cotton, and to the condition of the card wire may lead to material reduction in the formation of dead and immature nep and to the virtual elimination of process nep. But even when the attention to carding conditions exceeds that practicable in a normal mill, many cottons still give rise to pronounced neppiness.

It is also found that variations in subsequent processing conditions have some effect on yarn neppiness. As the number of drafting processes is increased yarn neppiness generally becomes more pronounced. Again, however, this does not help in obtaining a general solution for removal of nep from cottons prone to give trouble, because no spinner would find it practicable to make marked alterations in spinning conditions and equipment to cover abnormal behaviour.

Clearly, therefore, the only satisfactory remedy is to grow cottons which are not liable to give nep, and the most promising way of attaining this aim is to ensure that the fibre maturity is reasonably high, particularly if the cotton is fine.

It is well recognized that much of the raingrown American-type

cotton from countries in Africa is prone to nep. The frequency with which complaints are raised about this cotton has apparently caused many people to accept the trouble as being inevitable. These people tend to simplify the picture and compare African-grown cotton with the U.S. crop against which complaints are made much less frequently and about which many do not hear. The conclusion drawn is generally to the effect that in Africa cotton is grown in an unsuitable environment which results in the plant producing immature fibre giving a neppy manufactured product, whereas in America the plant is growing in its natural habitat and yields a satisfactory product. It will be shown that this is an over-simplification, and that there are strong reasons for asserting that fibre immaturity and neppiness are not an inevitable consequence of African conditions.

In the first place, all cotton grown in the United States is not mature nor are all samples free from nep. Some samples of American growths give yarns as neppy as many spun from the African cottons.

Furthermore, neppiness is not an invariant feature of all African-grown cotton of American type. Until recently the type known as Triumph was grown throughout most of the cotton areas in the Belgian Congo. This class of cotton is favourably received by many Lancashire spinners, one reason being that yarns spun from it are clean and practically free from nep. The Triumph cotton is now being replaced by a Stoneville type, derived from importations of seed from America. In the table below are given the results of fibre tests made on samples of these two types.

	Effective length ($\frac{1}{32}''$).	*Immaturity count* (*N-D*) *per cent.*	*Fibreweight per cm.* (10^{-8}*g.m.*)	
			Mean.	*Standard.*
Triumph	33	44·20	206	252
Stoneville ..	35	41·22	172	216

The yarns spun from the Triumph cotton were satisfactory in appearance; those from the Stoneville type were fairly neppy. The test figures show that both cottons are moderately immature, and consequently the satisfactory performance of one and the neppy appearance of the other cannot be readily explained on grounds of variation in fibre wall development. The reason appears to be that Triumph cotton is a very coarse type (with a standard fibreweight of 252) which can tolerate a much greater degree of fibre immaturity than the finer Stoneville cotton with a standard fibreweight of 216.

Neppiness is occasionally met in a cotton as coarse as Triumph. Some time ago tests were made on two samples, one grown in the main

"Forest" region and the other in the "Bush." The former, with a moderately low immaturity result of N-D=42-24, was of acceptable appearance. The "Bush" sample was very immature, N-D=26-35, and neppiness was pronounced.

In regard to the cottons from the Empire areas, in all cases they are appreciably finer, of lower standard fibreweight, than the Congo Triumph type. Although the average fibre maturity of these Empire crops is not greatly different from the average of Congo Triumph, their increased fineness and their longer staple length are such that this low maturity cannot be tolerated without the cottons being liable to give neppiness trouble.

Neppiness is, of course, not inevitable in Nigerian, Uganda, Tanganyika, Nyasaland and raingrown Sudan-American cotton. The point is that in an average season the average maturity of these crops is sufficiently low to cause them to be *liable* to nep. Careful processing or the operation of other factors may result in no complaint; alternatively, the balance may be tipped in the other direction and neppiness may be pronounced. If the *average* level of maturity could be raised then the crops would emerge above the danger line and neppiness would occur less frequently. There would, of course, still occur occasional bad seasons or local poor growth conditions leading to trouble, but these are inevitable in the crops of any country.

Whether the average level of fibre maturity can be raised by plant breeders depends upon whether fibre immaturity is a genetic factor. Up to the present many people have surmised that maturity is either not genetic, or alternatively that any genetic effects are small and are completely masked by preponderating environmental effects. In the final part of this article we shall establish the genetic nature of fibre maturity and show that it may be sufficiently marked to stand out above the ordinary physiological variations in growth conditions.

The first set of evidence offered is from tests made at the Institute on a series of samples of nine selected families of U4 origin, grown by S. T. Hoyle in Nyasaland.* In 1936 a total of seventy-two single plant selections were taken from these families, and in 1937 four progeny

	Degrees of Freedom.	*Mean Variance of Maturity ratio.*†
Between families	8	·0427
Between progenies in same family	63	·0102
Within progenies	216	·0029

* A joint analysis of these data was given in the report of the Third Conference on Cotton Growing Problems, 1938.

† The maturity ratio combines the percentages of normal (N) and dead (D) fibres into a single measure and is equal to (N-D)/200+0·70.

daughter plants were raised from each of the 1936 parents. The analysis of the maturity ratios for the progenies is given on the previous page.

The differences between the mean variances are statistically significant. Greater variance occurs between families than between progenies in the same family, which in turn is greater than the variance between the four separate progeny plants.

The mean values of the four progeny plants were correlated with the corresponding values given by the parents in the first year. The correlation between families yielded a value of $r = +0{\cdot}44$, and within families the correlation coefficient was $+0{\cdot}60$. The second of these coefficients is statistically significant but the first is not, possibly on account of the small numbers (nine families) involved.

Thus there is evidence to show that maturity is genetic in character, but since both progeny and parents were grown at the same place, in two seasons only, it is not satisfactory to conclude that the differences noted are due entirely to marked consistent hereditary differences. A differential environment effect, varying according to strain, would cause parent and progeny grown at the same place to be similarly affected, and result in a positive correlation between parent and progeny. What we also need to determine is whether the genetic effects on maturity are sufficiently marked to predominate over such possible differential environmental effects.

Results are available from a series of trials on two Nigerian cottons, 26C and Allen. The 26C strain was derived by continual single plant selection from a plant D31, itself selected from the 1931 commercial crop of the Standard Allen type. From a period of several seasons we have extracted all pairs of samples of these two strains grown under identical conditions at the same place. The results of the immaturity tests are given in the following table.

Season.	*Place.*	*Immaturity Count.*		*Maturity ratio.*	
		26C.	*Allen.*	*26C.*	*Allen.*
1939-40	Samaru	61-12	53-19	·945	·87
1942-43	"	43-15	48-14	·84	·87
1943-44	"	49-19	36-24	·85	·76
1943-44	"	54-16	45-22	·89	·815
1945-46	"	57-11	52-17	·93	·875
1945-46	Daudawa	55-12	54-15	·915	·895
1946-47	Samaru	52-15	49-18	·885	·855

The 26C selection has given an average value of 0·894 for the maturity ratio, compared with 0·849 for Standard Allen. The usual statistical tests indicate that the difference is significant and we are justified in concluding that the superior maturity of 26C is caused by the action

of genetic factors. In spinning tests on the above material the greater maturity of 26C was reflected in improved yarn appearance. In six out of the seven comparisons 26C was appreciably less neppy than Standard Allen. Other samples tested at the Institute confirmed that 26C gives a more mature fibre and a less neppy yarn than Allen, but since these did not fall into strictly comparable pairs the results were not included in the above comparison.

In Nyasaland we have noted that the selection CL20, and some re-selections such as CL20-20, have consistently given greater maturity figures (about N-D=54-13) than the Crown Land Bulk stock (with N-D=44-22 approx.), from which they were derived.

Seven samples of the strain BC5/14 (derived from an initial cross between the B181 and BP52 strains) were received from different localities in Uganda over a period of three seasons. With each sample was sent a sample of BP52 grown under identical conditions. For each comparison BC5/14 was more immature than the BP52 type, the immaturity count figures averaging 35-22 for the former and 43-18 for the latter, again a significant difference.

For many years the Pump Scheme Strain has been the main variety grown in the Nuba Mountains area of the Sudan. Extensive trials have also been made on the Deltapine variety, from seed imported from America, and we have noted that this cotton has consistently been immature. Omitting all except pairs of samples grown under strictly comparable conditions, the following table illustrates the difference between the two cottons.

Season.	*Place.*	*Immaturity Count.*		*Maturity ratio.*	
		P.S.S.	*Deltapine.*	*P.S.S.*	*Deltapine.*
1941-42	Talodi	53-19	46-19	·87	·835
1942-43	Kadugli	38-20	35-22	·79	·765
1942-43	Talodi	35-30	8-51	·725	·485
1943-44	Talodi	50-15	43-22	·875	·805
1944-45	Kadugli	48-19	41-25	·845	·78
1944-45	Talodi	43-23	33-30	·80	·715

In each comparison the Pump Scheme Strain was more mature than the Deltapine variety, the average values of the maturity ratio being 0·82 and 0·73 respectively. This difference was reflected in yarn appearance, in each case the Pump Scheme Strain giving a less neppy yarn than Deltapine.

Constant immaturity differences have been noted in cottons other than those of African-grown American seed, as is shown by the two following instances.

The table below gives an analysis of the variance in maturity ratio determined on eight strains of Sea Island cotton, grown in a randomized four-block layout under ordinary St. Vincent conditions. Independent duplicate immaturity tests provide an estimate of residual sampling error.

Source.	*Degrees of Freedom.*	*Mean Variance of Maturity ratio.*
Varieties	7	·0142
Blocks	3	·0034
Varieties and blocks ..	21	·0015
Duplicate tests	32	·0012

The results show that real differences in maturity exist between varieties. The strain B.S.I. was the most immature (average maturity= 0·83) and the superfine N.S.I. strain showed the greatest degree of fibre development (average maturity ratio=0·96). The results of a few other tests on comparable samples of these two cottons grown in other seasons are in accord with the above conclusion, that genetic factors operate to produce consistent differences in fibre maturity in the two strains.

Finally, the following extract is from a paper by the author on " The Production and Characteristics of the World's Cotton Crops, Part III, Sudan," to be published shortly. The data refer to two strains of the X 1730 Sudan Sakel type, grown at different places under irrigated conditions.

" Fibre and spinning tests have been made on a range of sixteen pairs of samples of X 1730A and BAR X 1730L sent in from 1942-43 to 1945-46. The average results of these tests are as follows:

	Immaturity count. (*N-D*)	*Maturity ratio.*
BAR X 1730L ..	59·9	·95
X 1730A	64·8	·98

In only one pair of the sixteen comparisons was the BAR type found to be more mature than the susceptible X 1730A type. In eleven cases X 1730A was appreciably more mature than BAR X 1730L, with little difference in the remaining four cases. In half of the comparisons BAR X 1730L and X 1730A were considered equal in yarn appearance, in seven cases X 1730A was ranked superior to BAR X 1730L, and only once was BAR X 1730L better than X 1730A. This

difference in yarn appearance appears to be associated with the maturity of the cotton."

We may therefore conclude that, after allowing for secondary effects of variations in fibre fineness and staple length, cottons of high fibre maturity are likely to give less neppy yarns than those of lower maturity. Furthermore, the data above are sufficient to establish that fibre maturity is partly determined by genetic factors which may produce markedly consistent differences in cottons grown under varying environmental conditions, even when those conditions are uniformly favourable to a high degree of development of secondary thickening.

As yet it is not possible to say anything definite regarding the nature of the genetic effects. No direct selection for fibre maturity has yet been carried out under critical and controlled experimental conditions, so that observed differences in maturity can only be regarded as fortuitous, having become established in the course of previous breeding for other plant and fibre characters. Until direct selection for fibre maturity is attempted it is neither possible to determine whether this character is highly polygenic or whether a limited number of major factors operate, nor to estimate the degree to which it is possible to build up potentiality for adequate secondary thickening. Nevertheless, the available evidence is sufficiently strong to assert that marked improvements in neppiness may be obtained by critical plant breeding methods designed to obtain improved fibre maturity, and that there is ample scope for this work in the field of the African-American cottons.

Received May, 1948.

PASSENGER TO CHAD

BY

E. O. PEARSON

Empire Cotton Growing Corporation

ONE of the advantages of air travel, we are told, is that keen business men, their brief cases loaded with literature to speed the export drive, can plan their journeys with split-second precision, flying with bee-like efficiency from client to client, waiting with open arms and pockets full of orders on airfields scattered all over the Empire's air routes. Those who have spent much time on the job, however, know that for every hour in the air at least two seem to be spent on the ground, usually penned within one of a series of waiting rooms, identical save for their temperature and the nationality of their waiters, which so often represent all that one sees of the places in the romantic and tantalising travel posters which decorate their walls.

More or less inured to delay, therefore, it was with resigned fatalism that one received the telephone message, just before starting on the journey which would eventually take one across to the other side of Africa, saying that there was a hitch. The official at the other end of the line was apologetic, but not optimistic. There was a fog in London. It was unlikely that the aircraft could take off. No one could say when it might reach West Africa. So that I, lucklessly and improvidently dependent upon it for transport between two points on its return journey, would, vulgarly, have had it. Looking out of the open doorway onto the blazing sunlight and glittering white drive between beds of scarlet and yellow cannas and hearing faintly from the back verandah the voices of the cook and the steward boy raised in argument and protest against the monstrous, the iniquitous prices of the wares displayed by the itinerant vegetable seller, it was difficult to believe that the murk and gloom of London had anything to do with me. However, such are the marvels of modern transport that foul weather, instead of merely incommoding the eight or nine million odd people who are groping their way about immediately underneath it, has been able greatly to extend its range of effectiveness and can now make matters inconvenient to exiled citizens several thousands of miles away.

But there was a gleam of hope, which became reality the following morning, in the windless, oppressive darkness before an uneasy dawn, in the shape of a Dakota from the Gambia, with a spare seat in it,

which bore me off, through low cloud and over an oily sea, away from the bleached brilliance of the Gold Coast, with its miles of tawny beaches, edged with iridescent seas and surf, its ancient white forts and its villages of gay and active fisherfolk, with their curiously carved and ornamented sea-canoes and tumbling swarms of plump brown children swimming and frolicking in and out of the waves—away to the dark mangrove creeks and sub-aqueous forest glooms of the Nigerian coast to the east.

Here further trouble waited. For, after circling an hour over the swathed tree-tops waiting for the early morning mist to clear, and noting with mild concern the tops of giant silk-cotton trees loom up and flash past the wing-tip on our first essays at landing, we at last came safely to earth only to find that the machine which should have carried me on was fogbound further along the coast and could not make it that day. Dogged by fog, my whole enterprise hung upon a hair, for unless by lucky chance Kano could be reached before lunch next day, the one plane a fortnight into French territory would go without me, and my carefully wrought time-table, which had seemed to fit its jig-saw intricacy so well together when first pieced from the pages of the "Air Bradshaw," would disintegrate.

So in the end it proved: after a day of rumours and counter-rumours diversifying the *longueurs* of twenty-four hours spent in the Government hostel, the next day's scheduled flight took place at the appointed time and not a moment earlier, depositing me with maddening precision at Kano half an hour after the French plane had left. A fortnight of sight-seeing, or alternatively a dubious trip by hired lorry over the six hundred miles of villainous track separating me from my rendezvous with the French, seemed my fate.

But one had gained, in this desert fringe of West Africa, a region and a climate more congenial to magic carpets, and the news awaited me that, of all improbable events, there would be in two days' time a Lebanese aircraft going back empty after delivering a cargo of wealthy Syrian merchants from Beirut to Lagos. Once again one settled down to wait.

The airport boasts an hotel. Like all airports, it is infinitely far from anything else, for most of the time a windy, deserted spot, with shimmering tarmac runways, silent buildings, an occasional trio of ground-staff walking over from the control offices to the hotel buildings to lunch and to flip over the tattered pages of the week old newspapers, mostly in other languages. At intervals throughout the day, activated by some mysterious prescience, a little group of white-robed Hausa traders would silently materialise round the entrance to the airport building, like vultures discreetly gathering in the neighbourhood of a kill, unobtrusively settle themselves on the ground and begin

to spread out their wares: the brightly coloured bags, the leather pouffes, the ivory elephants, the striped pieces of hand-woven goatswool and cotton cloth, the scarlet slippers. Soon after there would be a faint, a half-heard note borne on the wind, clearer for an instant, then dying away, until quite suddenly it would begin to swell to an enormous, an overpowering, inescapable roar and down upon the airstrip would float a gigantic Constellation, halting for a moment in its breathless rush from Paris to Johannesburg to allow the passengers to eat a hurried snack and to chaffer and bargain with the incurious Hausa traders. After twenty minutes they would be shepherded back by impersonal loudspeakers into their juggernaut, which would scream off, bellowing, into the blue-grey heat haze, and the little group would pack their wares and silently fade away again into the empty landscape.

The city, by contrast, was a shattering pulsation of light, dust and colour. Along the roads converging upon it the groundnut lorries rattle and roar, there are flocks of sheep and goats being driven along, horsemen on small, nervous Arab horses, magnificently caparisoned with their saddle cloths, their billowing *rigas*, their decorated swords, their curiously oriental conical straw hats, gay with fluttering leather ribbons; even a few camels sneer about the streets, loaded with bags of grain or cola nuts. Profiting by enforced delay, and guided by a friendly agricultural officer, cotton was sought within the gardens which lie just outside the city ramparts, protected by a low mud wall from the sparse pasturage which surrounds them. A nimble urchin led us to a group of bushes in a corner, beside a scummy water-hole, where a crimson flowered Asiatic tree cotton was growing, surviving relic of the culture brought across the sub-Saharan region from the Sudan and, before that, from India, with the hand-spinning and narrow-strip weaving still practised by the Northern Nigerian men. It was full of intriguing pests and we spent a happy half an hour gathering up specimens and reflecting upon the chances which had brought them there. We visited the new mosque, supported by contributions levied upon the faithful and erected with great skill and doubtless at great expense by the infidel hands of the Public Works Department. It was fashioned of shining white concrete blocks, the ceilings decorated in gaudy yellow and blue and crimson painted lozenges, and, climbing up to the little circular gallery at the top of one of the four minarets, we looked directly down upon the multitudinous city.

The whole feel of it is Sudanese: the white-robed men and the women in their graceful head veils of dark blue, the narrow alleyways and flat-roofed houses, surrounding the courtyards stacked with millet straw, where the horses or donkeys are tethered, the deep pits from which generations of city-dwellers have taken the clay to build their houses, and which today are filled with creaming water. There is a

piped supply now, with storage in the flat-topped ironstone hills which lie within the vast perimeter of the city walls, but sheep, goats, ducks and children still drink and quack and splash in the ancient tanks.

Outside the walls of the old city there are the wide streets of the commercial quarter, with the trading houses, the Government offices, the Post and Telegraphs and the banks, and here one comes across the curious and unexpected spectacle of the dusty ex-Army lorries, the converted ambulances, the rehabilitated radio-trucks belonging to the Overlanders. The Overlanders are a new but characteristic feature of the roads of post-war Africa: a traffic which begins in the towns and suburbs of England, slipping down in ones and twos to the ports, joining up with other groups in France and Spain and forming small convoys across the trans-Saharan caravan routes, halting for a few days at the French military posts, beleagured by enormities of sand and sky, and finally grinding their way through to Northern Nigeria.

Here they halt while they put the big-ends back again, recover from the horrors of the journey and institute legal proceedings against other members of the party. For while these travellers who quit the austerities and frustrations of post-war England for the hopes, or fantasies, of glittering jobs in southern Africa are for the most part people of solid worth, matter-of-fact confidence and unspeculative optimism, there are others the prey of sharks and scallywags who decamp with the party funds in Marseilles or Algiers, or strand whole groups of families for weeks on end in remote desert forts waiting for incompleted formalities to be fixed up. Kano seems to be the place of reckoning.

There were several families sharing my hotel. The children are the happiest, especially the little boys. Burnt brown by the sun and sand, wise in the ways of camping life and intoxicated by this glorious and apparently permanent release from the bondage of schoolmasters, clean suits and classrooms, they proudly assist their sweating parents grovelling in the dust repairing lorry springs, race along the airfield fence watching the liners coming in to land, chatter endlessly to the puzzled but patient African hotel servants, and eagerly canvass the possibilities of meeting elephants, lions and hippopotami upon the onward road.

At length my Lebanese plane arrived and picked me up—its sole passenger. At Kano it had been pleasant, with crisp air smelling of the desert, bathed in golden sunlight, but up aloft it grew chilly, with a ground haze which turned the earth to a sombre brown, amorphous mass over which we droned endlessly in the sad afternoon light. It was almost dark when we reached our destination in French territory —an attenuated scatter of houses, barracks and various civil and military installations along the banks of the River Chari, which coils

its sullen and overcharged length through an illimitable flat plain, half baked mud and half swamp, towards Lake Chad, the leaden waters of which I thought I could see glistening to the north before we came in to land. With the aircrew—whose French, with a Levantine overlay, I found almost as difficult to understand as they evidently did my halting fourth form phrases—I sought the nearby hotel, a slightly squalid hostelry on the river bank, with a little paved terrace overlooking the darkling water, hung with a few fluctuating coloured light bulbs, and backed by a café-bar, filled with groups of young soldiers mildly celebrating the New Year—for it was the first of January.

The few and rather sketchy arrangements which it had been possible to make for a rendezvous had clearly and inevitably been badly upset by the chain of events set off by that fog in London, so next morning it was necessary to reconnoitre my position. A lift into town, some distance away, with the Portuguese hotel proprietor and a search in all likely places having yielded a blank, the moment had evidently come when assistance at the Highest Level had to be sought, so my guide, a very small African child, was bidden lead me towards the Governor, which he did, bearing on his head my heavy brief-case, through the wide, glaring streets, fringed with tired fig trees, past the shuttered houses along the river bank and the groups of African soldiery eyeing me curiously from the porticoes of the police post and the barracks. No welcome could have been warmer or friendlier: within the hour I was set upon my way, refreshed and fortified, my kit piled into a car, and with a driver of great skill, daring and taciturnity I was heading south over the four hundred odd kilometres separating me from the experiment station which was my destination.

It was pleasant, after the uncertainties of the last few days, the feeling that one's arrangements were at the mercy of the whims of circumstance, the burden of the huge distances which had, somehow, to be covered in a limited time, to sit back and have nothing to do or worry about other than to look out of the car at the strange countryside of the Chad basin. It has the fascination of all remote places and, knowing something of the more conventionally travelled routes of Africa, there was a special feeling of being this time really off the beaten track.

This gigantic inland drainage basin, half land and half water, is a kind of African fenland, its dark grey clays, whitish silts and pale brown sands deposited in such barely perceptible changes of level that the waterways which go meandering across its surface seem unable to decide whither they will really flow. The Chari and Logone rivers, which are the easterly and the westerly of the two great watercourses, both rise in the high land of the Cameroons, not far from the source of the Benue River, which itself runs left-handed to cross the frontier

and join up with the Niger. But the Chari and the Logone have no such determination: they drift and loop lazily northwards, dividing and rejoining, linking up with scores of lesser channels and tributary dikes, to lose themselves eventually in the spongy and amorphous maze of morasses, marshes and half-drowned sand dunes which is Lake Chad, reputed home of myriad legions of mosquitoes, frogs and aquatic birds, and of the fantastic Chad cattle, whose sweeping horns, inflated at their base into great spongy masses of cellular tissue, are said to support their heads as they swim from one to another of the thousand islands which provide their pasturage.

The Logone is the less decisive of the two, for half way along its dilatory journey a part of its waters turns aside and, during the rains, which are brief but torrential, filters through the lakes and marshes of the Toubouri depression to emerge as the Mayo Kebbi, which traverses the Northern Cameroons and finds its way to the Benue and the Niger. The waters of the Logone are thus in danger of being captured and diverted to the Gulf of Guinea, a process which was accelerated in German times, when the Canal de Ham (aptly named, in a country where one feels that Noah, Shem and Japhet also would have felt much at home) was dug to connect the two drainage systems more directly. The French authorities are concerned at this and the geologists of the Mission Logone-Chari are working now in the area, taking levels and planning means to control and develop this bewildering network of waterways.

Late that night I was deposited, tired, dusty and dishevelled, at the headquarters of the official administering this region—to be met with French elegance and comfort, much questioning about the state of Europe and a kindly patience with one's still-halting phrases in an unaccustomed language. It was an experience typical of the days which followed, to find these tiny and isolated stations, scattered so thinly amongst the vastnesses of French Equatorial Africa, inhabited by families of French people—administrators and other officials, employees of the cotton companies or transport firms—whose wives recreate, amongst all the difficulties and hardships imposed by communications which for months at a time depend solely upon horses or native canoes, the family life of the French countryside; who busy themselves with their households, their cooking, their children and who evoke in some miraculous way the illusion that they are in the midst of civilization, preserving in these fantastically outlandish surroundings the culinary and conversational graces of metropolitan France. It would be an impertinence to commend them for what is regarded as a natural and a normal attitude, but after many weeks spent travelling among and with them, one's admiration is compelled for the gallantry, the *panache* with which they face colonial life.

Of all the places visited, none was more lonely or isolated than the research station which was reached early in the morning of the second day. Two houses and a small *case de passage*, a laboratory building and a workshop comprised its all, together with the station lands and the native village nearby, set on a gentle slope leading down to one of the lakes. All around is flat, grey-brown or darker clay soils, with thin grass growth and sparse thorn bush and palm trees, but at the time of year—the early dry season—the landscape was not unpleasant, with its soft pastel colourings of smoky blue sky, golden grass, buff or grey soils, and, all around the margin of the placid blue lake, the fresh green marsh grass. There were immense quantities of aquatic birds, sandpipers, sacred ibis, herons and great flocks of crested cranes. One sees these last, in pairs or small groups, around the East African lakes, but here they were by the hundred and if one put up a flock of them, they would circle round in a stately procession, uttering strange honking cries reminiscent of a noisy traffic jam in a continental city.

Along the margins of these lakes and sluggish waterways of the Chad basin lives a most primitive and untouched people, insulated by this wilderness of marsh and clay plains, lacking communications and little visited by trader or missionary, withdrawn into their remote inland fastnesses. There are many tribes and clans, the Toubouri, the Moussai, the Moundang, each with slight variations in their dress or decorations, their weapons and their habitations, but all pagan, uninfluenced by either Christian or Mahommedan. Clothing is unknown, save that the men wear a piece of goatskin tied over the buttocks and the women a waist-string to which is attached, behind, a curious switch of rope fibre which flows out like a centaur's tail. The women wear small discs in the lips and sometimes, in the Mayo Kebbi region, one sees what are almost duck-billed creatures, whose lips are stretched round two quite sizeable plates. They would get on well with Donald Duck. Through their ears, too, are stuck sharp ornaments and across the cheeks and nose are strung a glittering, tinkling collection of chains and prickly baubles. The men are of splendid appearance, tall, straight and muscular: they affect a variety of head-dresses, the hair being sometimes shaved except for a top-knot, or a central ridge, which often ends in a short pigtail. They carry an extensive armoury of sticks, knives and a great bladed lance, and sometimes also an evil-looking instrument with two cutting blades set at right-angles, which is launched through the air spinning flat, like a boomerang, and is used for hamstringing game.

The homesteads of the Mayo Kebbi people are little beehive-shaped, thatched-roof, mud-walled huts, grouped round a cluster of curious gourd or bottle-shaped grain stores. Among some clans the dead are buried just outside the ring of huts in cemeteries resembling immense

anthills, covered in broken pots and calabashes and surrounded by a stockade of massive timbers, the tops of which are smeared in red. They must go miles to find these stakes, for there are no large trees close at hand. They grow vast quantities of guinea-corn on the clay plains after the floods recede, and at the time I was there the landscape bore an almost European aspect, with the yellow heads of ripening grain stretching everywhere as far as eye could see.

Here is no tsetse fly and along the edge of the marshes were great concentrations of cattle and horses. The men are incredibly expert riders, using no saddle, stirrup or bit, holding their rope halter in one hand and their fearsome armament in the other, and in this way running down and spearing antelope, with the help of their packs of dogs, which are swift and fierce.

There is much spearing and trapping of fish, too, and this is perhaps better developed in another part of the Chad basin, which we traversed some days later, where the people bear the name, ludicrous to our ears, of the Bananas. Here the land is so flat and so little raised above the river level, that in the rains the whole countryside becomes a vast, shallow lake; it is utterly treeless and the only crop cultivated is rice, sown in long parallel narrow beds separated from each other by similar strips of grass fallow—an unusual system of literally alternate husbandry. The few slight eminences are crowded and crammed with huge agglomerations of huts, so that, approaching them across the plain towards evening, one can see from far away the pall of smoke from hundreds of cooking fires hanging heavy in the still, settling air.

Into this primitive society, with its ancient habits and immemorial customs, has been introduced the cultivation of a new crop, cotton. It is one well suited to much of this region: the climate is ideal, with its single rainy season followed by warm, dry weather giving perfect conditions for ripening and picking; the soils, though sometimes too sandy and often poorly drained, nevertheless include great tracts of fertile clays and well-developed loams. Indeed, anyone who knows cotton in Africa can recognise this area as familiar and good.

Cotton has been little grown before: these people have no use for clothing. Nor have they yet become aware of any need for cash. Here one finds few traders: unlike the East African countries, no lines of shanty stores with their Indian proprietors mark the approach to the cotton buying stations; the people's few and humble wants are supplied from the clay with which they build, from the miles of flat or gently undulating grass savannahs over which they hunt, from the rivers and lakes beside whose margins they live and die. The piece goods, the pots and pans, the bush lamps and bicycles which mark the onward march of civilisation in the less sequestered parts of Africa are lacking here—and are scarcely missed.

But Western Europe needs her raw cotton and the people of the Mayo Kebbi needs must grow it. They receive their franc notes for it, they pay some of them over in taxes and with the rest—they buy cattle from the Cameroons. Over the western border of the Chad Province there is little cotton to be seen because, the French Cameroons being mandated territory, its cultivation has never been compulsory. It is a very different countryside: one leaves the alluvial flats and comes to a hilly region, studded with smooth-sided, shining granite tors upthrust from the earth like giant monoliths, around the bases of which are grouped the stone and thatch villages. I was uncertain of the real nature of the inhabitants, but some of them were Foulbé people, and they seemed close, in appearance and customs, to the settled Fulani of Northern Nigeria. They are much more civilised than the naked pagans of the Mayo Kebbi: their men wear the *riga*, the loose white garment with wide armholes and sleeves, often swathed up round the neck and lower face in an almost medieval fashion, characteristic of the Arabised races throughout West Africa, and on their heads the conical straw hat, or a very odd type shaped for all the world like a giant chamber pot, or sometimes a white cotton nightcap. The women wear the head veil and richly patterned draperies: they are fine featured, often pale skinned and though barbarously tattooed and wearing brass nose ornaments, are striking and graceful figures.

These people keep very great quantities of stock—cattle, horses, donkeys, sheep and goats—and the whole region is terribly overgrazed in consequence. Around the villages is a wilderness of dust and droppings and the gardens and patches of cultivation near the house-sites have often to be fenced in. Here there is some cotton grown, not the Upland varieties of the export crop areas, but the *punctatum* cotton, a much earlier introduction from the New World, which has filtered across Africa from the slave coast, supplanting the even earlier Asiatic types. The Foulbé cultivate it for their own hand-spinning and weaving and prefer it to our modern varieties, but it is usually grown as a perennial and by consequence yields as rich a harvest of pests as of cotton. It is an odd situation that the Foulbé, who are traditional cotton growers, should thus have no part in its production for export and that this should be carried on entirely by the pagan tribes, who have no use for it at all.

The problems of developing the Chad basin are forbidding. There is the difficulty of communications: there is no railway anywhere in French Equatorial Africa except for a few miles of track at the coast; they depend for shifting goods upon two waterways, the Oubangui, tributary of the Congo, and the Benue. The latter is only navigable for a few short months in the rains, and in the rains the whole system of road communications feeding the river ports is threatened and, in

the Chad basin itself, utterly impassable. There is the problem of developing this extremely primitive people, whose conscious needs are so few and easily satisfied and who, poor things, are innocent of the cash nexus. Indeed, money is today for them of doubtful value, for France, desperate herself for essential manufactured goods, has exported chiefly luxuries to her equatorial African colony, and while one can find, even in quite remote settlements, a choice of several brands of liqueur and even perfumes or tins of *pâté*, in the few roadside stores there is still hardly anything that an African would wish to buy.

But if the difficulties seem great, the possibilities match them. These clay and silt plains are intrinsically rich and the flood waters which now, if not actual enemies, are at best uncertain friends, could, if tamed and regulated, enormously enrich and diversify the agriculture. The two greatest impediments to stock-raising—tsetse fly and lack of water—do not exist here, as the sleek herds which one sees everywhere bear evidence. With soils well suited to grain crops, to groundnuts and to cotton, with no great pressure of population on the land, so that the problems of overcultivation and erosion have not yet become serious, and above all, with cattle, there seem rich possibilities for building here a settled, well-planned and properly balanced farming.

I met many of the men who will have to work out these problems of agriculture and development. They are in pathetically small numbers in comparison with the huge and remote areas in which their work lies. But they have a resourcefulness, an adaptability and an inward gaiety which meets and outfaces the difficulties. Many belong to the new generation: young men whose intelligence and ardour have been toughened by the experiences of a youth spent in wartime Europe. They are aware of the place of African development in today's calculations of the pattern of Western Europe's economic life, and of the responsibility and opportunity held in common with British and Belgian neighbours. They are good colleagues, and good friends. I spent an arduous and happy time with them and parted from them with respect, and regrets.

Received May, 1948.

DEVELOPMENTS IN THE WORLD RAW COTTON SITUATION DURING THE 1947-48 SEASON

BY

DUDLEY WINDEL

A REVISION of world production and consumption statistics for the present season to date indicates that the carryover on July 31, 1948, will show a reduction of around 3,000,000 bales on the figure for a year previous, and of no less than 12,250,000 bales on that for July, 1945—the year of the war's termination.

SUPPLY AND DISTRIBUTION OF ALL COMMERCIAL COTTON IN THE WORLD*

AMERICAN IN RUNNING BALES; OTHER COTTONS IN EQUIVALENT 478 LB. NET BALES (000's OMITTED)

Season	*Carryover*	*Production*	*Total Supply*	*Consumption*	*Destroyed*	*Carryover July 31*
1936-37 ..	13,649	30,729	44,378	30,638	45	13,695
1937-38 ..	13,695	36,745	50,440	27,573	165	22,702
1938-39 ..	22,702	27,509	50,211	28,507	66	21,638
1939-40 ..	21,638	27,326	48,964	28,496	206	20,262
1940-41 ..	20,262	28,720	48,982	26,595	220	22,167
1941-42 ..	22,167	25,616	47,783	25,033	165	22,585
1942-43 ..	22,585	25,582	48,167	24,293	304	23,570
1943-44 ..	23,570	24,521	48,091	22,566	121	25,404
1944-45 ..	25,404	23,631	49,035	22,204	233	26,598
1945-46 ..	26,598	19,890	46,488	23,110	337	23,041
1946-47 ..	23,041	20,279	43,320	25,893	205	17,222
1947-48 ..	17,281	23,349	40,630	26,210	200	14,220

* Source: New York Cotton Exchange to 1945-46. Writer's estimate 1947-48.

The revised world production total of 23,349,000 bales for 1947-48 shows an increase of 3,070,000 bales on the 1946-47 out-turn. This increase reflects almost entirely an expansion in the U.S.A. cotton crop from 8,562,000 bales in 1946-47 to 11,600,000 bales in 1947-48, production of outside cottons showing little change in the aggregate at around 11,700,000 to 11,900,000 bales. The 1947-48 South American crops were again disappointing, owing either to smaller planted acreages or unfavourable growing seasons. African crops showed no important variation. The Chinese cotton crop was larger than in 1946-47, but commercial supplies were reduced to small proportions by the civil war. An increase in Russian production was about offset by a decrease in the Indian harvest, caused partly by the communal troubles in the Punjab.

The revised estimate of the total world supply for 1947-48 is 40,630,000 bales, as against 43,320,000 bales last season, and the war-time accumulated peak of 49,035,000 bales for 1944-45. Details of the July, 1947, carryover and the 1947-48 production are given below:

WORLD CARRYOVER AND PRODUCTION OF COMMERCIAL COTTON IN THE WORLD*

AMERICAN IN RUNNING BALES; OTHER GROWTHS IN EQUIVALENT 478 LB. NET BALES (000'S OMITTED)

World Stocks, July 31, 1947.		*World Production*, 1947-48.	
U.S.A.	2,520	U.S.A.	11,600
Canada	140	Mexico	490
Mexico	200	Other N. America	26
Other N. America	10		
Brazil	1,800	Brazil	1,200
Argentina	350	Argentina	330
Peru	186	Peru	320
Other S. America	70	Other S. America	90
U.K.	1,950	Continental Europe	120
France	600		
Italy	700	Russia	2,900
Russia	800	Turkey	240
Germany	150	Persia	80
Holland	120	India	3,200
Belgium	300	China	300
Switzerland	100	Burma	34
Sweden	90	Other Asia	250
Spain	80		
Czechoslovakia	105	Egypt	1,300
Yugoslavia	40	Belgian Congo	190
Poland	60	Uganda	140
Other Continent	40	Tanganyika	30
		Nigeria	20
India	3,600	French Africa	120
China	450	Portuguese Africa	110
Other Asia	200	Sudan	230
		Other Africa	24
Egypt	1,350		
Belgian Congo	100	Australia	5
Other Africa	400		
Japan	200		
Australia, etc.	70		
Afloat	500		
	17,281		23,349

* Revised.

The indicated total world consumption of raw cotton in 1947-48 at 26,210,000 bales is only slightly larger than the 1946-47 figure of 25,893,000 bales. This is largely owing to the probable decline of around 1,000,000 bales in U.S.A. consumption, which almost offset the further recovery in Europe, Russia and the Far East.

CONSUMPTION OF COMMERCIAL COTTON IN THE WORLD AND PROSPECTIVE CARRYOVER

American in Running Bales; Other Growths in Equivalent 478 lb. Net Bales (000's omitted)

*World Stocks, July 31, 1948.**		*World Consumption, 1947-48.*†	
U.S.A.	3,000	U.S.A.	9,000
Canada	120	Canada	350
Mexico	150	U.K.	1,900
Other N. America	10		
		France	1,100
Brazil	1,300	Germany	250
Argentina	300	Italy	650
Peru	200	Belgium	420
Other S. America	70	Czechoslovakia	250
		Holland	250
U.K.	1,500	Poland	340
France	400	Spain	300
Italy	300	Switzerland	100
Russia	800	Portugal	150
Germany	100	Sweden	120
Holland	150	Other Continent	230
Belgium	300		
Switzerland	70	Russia	2,300
Sweden	60	China	1,600
Spain	40	India	3,400
Czechoslovakia	60	Japan	800
Yugoslavia	40	Other Asia	500
Poland	50		
Other Continent	30	Brazil	1,000
		Argentina	380
India	2,300	Peru	60
China	400		
Other Asia	200	Other Countries	760
Egypt	900		
Belgian Congo	100		
Other Africa	350		
Japan	250		
Australia, etc.	70		
Afloat	600		
	14,220		26,210

* Tentative estimates. † Revised.

The tentative estimate of the world carryover of only 14,220,000 bales at the end of the present season shows a moderate increase in the U.S.A. stock, but sharp declines in India and Egypt. Stocks in other producing countries fell only moderately as they had already reached small proportions in July, 1947. The indicated decrease of 450,000 bales in the U.K. stock reflected a natural readjustment from the heavy 1946 accumulation, while the marked contraction in European continental stocks was due mainly to the importation difficulties of France, Italy and Spain as a result of a lack of foreign exchange.

In relation to the broad world-wide demand for cotton textiles, the expansion in world consumption of raw cotton in 1947-48 is disappointing. The population of the world has increased considerably since 1938, but in spite of this natural rise in clothing requirements consumption is still around 3,000,000 bales below the average pre-war level. Factors mainly responsible for the slow rate of recovery are: (i) the heavy damage inflicted on the Japanese and German textile industries during the war and the physical and other difficulties connected with their rehabilitation; (ii) the failure of the U.K. to reach pre-war textile production, largely owing to acute labour shortage; (iii) internal political strife in India and China; (iv) the adverse effect of monetary instability on international trade in both raw cotton and textiles, and (v) the growing competition from synthetic fibres, particularly rayon.

WORLD RAW COTTON PRODUCTION IN 1947-48

(*Revised*)

According to the latest advices from the principal cotton-growing countries, world production this season was as follows:

North America

United States.—The planted acreage is officially estimated at 21,500,000 acres and the harvested area 21,269,000 acres. The average yield per acre is given as 267·2 lb., giving a crop of 11,551,738 running bales, as against 8,517,000 bales in 1946-47.

Mexico.—The 1947-48 crop totalled 490,000 bales compared with 452,000 in 1946-47.

South America

Brazil.—In spite of a much smaller planted acreage, the 1947-48 South Brazilian crop at around 800,000 bales (equiv. 478 lb. net) was larger than the disappointing harvest of the preceding season owing to unusually favourable growing conditions. The Northern crop is estimated at around 400,000 bales (478 lb. net).

Peru.—The 1947-48 acreage was increased by about 25,000 acres to 335,000 and production at an estimated figure of 330,000 bales (478 lb. net) was about 60,000 bales larger than in 1946-47. Good yields were obtained in the Tanguis Valleys, but the Pima crop suffered from lack of water for irrigation.

Argentina.—The acreage was slightly increased this season but weather conditions did not favour the crop, and the indicated yield at 330,000 bales (478 lb. net) showed little improvement on the poor 1946-47 production.

Africa

Egypt.—The acreage under cotton in 1947 was again compulsorily restricted in view of the cereal scarcity. Sowings of Karnak were reduced, largely in favour of Zagora. The total out-turn at 6,249,991 cantars (*i.e.*, 1,330,000 bales of 478 lb. net) was slightly higher than that for the previous season.

Sudan.—Planted acreage and yields were little changed from 1946-47. Production of Sakel-types was slightly smaller, while the out-turn of American-types was correspondingly larger.

British East Africa.—About the same area was sown to cotton in Uganda, but yields suffered badly from adverse growing weather. The Tanganyika acreage and crop were maintained at the figures for the previous season.

Belgian Congo.—Lack of native labour and indifferent cultivation impeded progress in cotton growing, and the acreage planted in 1947-48 was rather less than in the previous season. The harvest at around 190,000 bales (478 lb. net) was approximately equal to the 1946-47 yield.

French Equatorial Africa.—The area under cotton has held more or less stable in recent seasons, and production has averaged around 25,000 metric tons of lint.

Nigeria.—Acreage and yields were well maintained, but the quantity of cotton available for commercial export was sharply reduced owing to the better prices paid for seed cotton by native weavers.

Asia

Russia.—No official statistics are released regarding acreages or production, but unofficial advices suggest that the 1947-48 area and crop were larger than in 1946-47.

India/Pakistan.—Acreage planted in both Dominions was again restricted in the interests of food production and showed little change from the 1946-47 total area. Yields in India were moderately better, but the Pakistan crop suffered from the vast migration of populations from Sind and the Punjab, which disorganized harvesting and ginning. The aggregate out-turn is estimated at around 200,000 bales (478 lb. net), less than that for 1946-47.

China.—Acreage sown to cotton in the Northern provinces was appreciably larger than in the previous season, but the extension of civil war to the cotton-growing areas virtually cut off the Shanghai mills from domestic supplies and it is doubtful if more than 300,000 bales (478 lb. net) will be available for commercial consumption out of an estimated production of over 2,000,000 bales.

Burma.—Acreage planted increased by 50,295 to 221,000 acres and

the yield at 7,500 tons was nearly double the 1946-47 out-turn. The Government is making active efforts further to expand cotton growing and to improve quality.

PROSPECTS FOR 1948-49 SEASON

The excess of demand over supply during the past three seasons has reduced world reserves to a low level, and this has been reflected during the period in a strong upward movement in world prices for all growths. The current level of values is highly attractive from the producers' standpoint, and indications are that the 1948-49 planted acreage in most countries will be larger than in 1947-48.

It is too early to make any predictions regarding the Southern Hemisphere countries, as their crops are not planted until autumn. In the Northern Hemisphere, however, planting is about completed. Mexico and California have increased their acreages to record proportions; the rest of the U.S.A., Egypt, and North Brazil are believed to have planted around 10 per cent. more land to cotton than in 1947. Russia claims to have planted a considerably larger area, and both Turkey and Persia report increases. In India, the Central Cotton Committee has recommended an increase of 4,000,000 acres in the 1948 plantings with a view to expanding production by at least 1,000,000 bales.

On present prospects, it would seem reasonable to look for a world production of commercial cotton next season of at least 26,000,000 bales under normal growing conditions in the various cotton-growing countries. World consumption in 1948-49 is difficult to forecast in face of the prevailing political unsettlements and monetary disequilibrium. However, taking into consideration the aid to European recovery from E.R.P. and the steady rehabilitation of the Japanese cotton industry, there would seem a good prospect of consumption keeping in step with the increase in production, even allowing for a further intensification of competition from rayon and other synthetic fibres.

From the longer-term standpoint, it is clearly evident that cotton will lose heavily to rayon unless the present wide price disparity between the two products is eliminated. Fortunately for cotton, the advent of mechanized agriculture promises substantially to reduce production costs in the next few years, thereby enabling the natural fibre to meet the challenge of synthetics on much more favourable terms.

RAW COTTON EXPORTS

Raw cotton exports from the U.S.A., Brazil, Peru, Egypt, India and Pakistan during the first half of the present season went to the following destinations:

IN RUNNING BALES EXCEPT PERUVIAN, WHICH IS IN EQUIVALENT 478 LB. NET BALES (000's OMITTED)

Country of Destination.	*From U.S.A.*	*From S. Brazil.*	*From N. Brazil.*	*From Peru.*	*From Egypt.*	*From Pakistan.*	*From India.*
	(*a*)	(*a*)	(*a*)	(*a*)	(*b*)	(*b*)	(*b*)
Canada ..	84	21	—	—	5	—	—
U.S.A.	—	—	—	23	33	31	36
Mexico ..	—	—	—	—	—	—	—
Cuba	9	—	—	—	—	—	—
Brazil	—	—	32	—	—	—	—
Peru	—	—	—	—	—	—	—
Argentina ..	—	—	—	4	—	—	—
Venezuela ..	—	—	—	—	—	—	—
Colombia ..	—	5	1	28	—	—	—
Chile	—	10	—	18	—	—	—
Uruguay ..	—	2	—	—	—	—	—
Bolivia ..	—	—	—	—	—	—	—
Other S. America	—	1	—	6	—	—	—
U.K.	160	48	—	42	88	14	25
France	75	38	—	—	95		
Italy	21	26	—	3	90		
Belgium ..	35	64	2	14	12		
Holland ..	23	51	2	12	5		
Spain	—	80	3	—	22		
Switzerland ..	2	1	—	12	17		
Germany ..	51	—	—	—	16		
Portugal ..	—	11	—	—	2		
Hungary ..	—	—	—	—	3	116	211
Poland ..	15	47	—	4	6		
Czechoslovakia	—	3	—	—	27		
Norway ..	2	5	—	—	—		
Finland ..	11	9	—	—	—		
Sweden ..	5	16	—	—	22		
Denmark ..	—	5	—	—	—		
Greece	1	—	—	—	2		
Yugoslavia ..	—	—	—	—	4		
Other Europe ..	—	—	—	—	—		
Syria/Lebanon	—	—	—	—	7	—	—
Palestine ..	1	—	—	—	2	—	—
India	—	—	—	4	89	113	—
China	7	4	—	—	2	39	158
Japan	357	—	—	—	5	33	137
Australia ..	10	19	—	1	7	9	—
South Africa ..	—	—	—	3	—	—	—
All Others ..	4	2	—	—	7	10	20
Total ..	873	468	40	174	568	365	587

(*a*) = August 1, 1947, to January 31, 1948.
(*b*) = September 1, 1947, to February 28, 1948.

REVIEWS

COLONIAL RESEARCH 1946-47. (Cmd. 7151. H.M.Stat.Off. 1947. 1s. 3d. net.) This Colonial Office White Paper contains the Fourth Annual Report of the Colonial Research Council, and reports of councils or committees dealing with Colonial Products Research, Colonial Social Science Research, Colonial Medical Research, and Colonial Agricultural, Animal Health, and Forestry Research.

The first-named report throws some needed light on the relationship between the numerous advisory Committees and Councils which have arisen in recent years as appendages of the Colonial Office, in contrast to the days, well within memory, when scientific suggestions reaching Downing Street were hastily referred to an official with the unusual qualification of B.Sc. or another with an amateur interest in geology.

The Colonial Research Committee, Chairman the Lord Hailey, acts as the central body advising the Secretary of State on schemes for expenditure initiated by the specialised advisory councils and committees, and also on schemes emanating from functional organizations attached to the Colonial Office, dealing with such matters as geological and other surveys, colonial fisheries, and tsetse fly and locust control.

The Colonial Research Committee admits the increasing difficulty of its situation between these bodies and the Secretary of State, charged with the duty of approving schemes submitted by experts and deciding upon their relative urgency and importance. A desire is expressed for a comprehensive programme to which after due consideration a general approval might be given, with liberty of operation within its scope.

The report records the progress so far made in the regional organization of research in the colonial territories, more especially in East Africa and the West Indies. The need for a general superannuation scheme for colonial scientific personnel is emphasized.

An appendix to the report gives a list of schemes approved for research grants under the Colonial Development and Welfare Acts for the period April, 1946, to March, 1947. This includes, *e.g.*, £19,350 for fundamental research on insecticides. plus £2,500 for the appointment of an officer to conduct research in the United Kingdom and advise on colonial insecticide problems; a further (supplementary) grant of £29,000 for experiments with DDT and other insecticides and repellents in East Africa. Tsetse fly and trypanosomiasis research and reclamation in East Africa is down for £234,660—two-thirds of the estimated cost of projects to be developed.

Further appendices list the members of the recently appointed Colonial Insecticides Committee and of the Colonial Economic Research Committee.

COLONIAL PRIMARY PRODUCTS COMMITTEE: INTERIM REPORT, JANUARY, 1948. (Colonial No. 217. H.M.Stat.Off. 1948. 6d. net.) The Colonial Primary Products Committee was called into being by the

Colonial Office in May, 1947, and has worked to the following terms of reference:

> "To review, commodity by commodity, the possibility of increasing Colonial production, having regard on the one hand to the interests of the Colonial Empire and, on the other hand, to the present and prospective world needs and the desirability of increasing foreign exchange resources."

The Report sets out under general considerations the general attitude of the Committee to the problems involved. Increase of production is regarded not merely as a measure to meet the immediate dollar emergency but as a long-term contribution to the stability of the sterling area and to European reconstruction plans. To offset the view that "a change in the pattern of Colonial agriculture can be brought about . . . almost overnight," the limiting factors in operation are discussed, and the reminder issued that the Colonies are not British estates which can be exploited by the United Kingdom for her own advantage. The rational and realistic views expressed in this discussion lead one to wonder by what political process the Colonial Office has been persuaded or constrained to resign, in appearance at least, its responsibility for their application in relation to some present policies.

In the section of the report dealing with commodity studies the situation regarding cotton comes under consideration. After reviewing the present position and giving favourable notice to proposals for expansion on lines similar to those discussed in this Journal, the Committee has recommended, in the knowledge that Lancashire's demand for medium staple cottons is, at present prices, of the order of £30-40,000,000 annually, "that the attention of Colonial Governments should be drawn to the need for greatly increased supplies of cottons of this type wherever this might be possible. In particular, the Governments of Nigeria, Uganda, Tanganyika and Nyasaland should be told the views of the United Kingdom regarding the acceptability of the cottons produced by them, and their price relationship having regard to spinning values. The Committee recommends that discussions should be continued on the question of price with a view to adjusting differentials so that maximum encouragement could be given to the sale of the medium staple cottons to the United Kingdom. As regards Uganda, the Committee does not consider that it would be advisable or practicable to lay down any prescribed quantity of these cottons which should be grown at the expense of the (at present) more profitable longer staple type. No change-over can be expected unless the relative prices offered are adjusted, possibly as the result of a long-term arrangement.

The Committee has had its attention called to the difficulties which spinners have recently experienced with Uganda cotton. These arise chiefly from defective grading and baling, and should be capable of remedy by a stricter application of existing ginning and marketing controls. It is hoped that it may be possible for the Raw Cotton Commission to station representatives in East Africa to assist in overcoming present difficulties, and the Committee has noted that one of its officials is paying a visit to East Africa during the forthcoming ginning season.

Recommendations for the Organization of Colonial Research in Agriculture, Animal Health and Forestry. A Report by the Committee for Colonial Agricultural, Animal Health, and Forestry Research. (Col. No. 219. H.M.Stat.Off. 1948. Price 4d.) The issue of this report as a White Paper follows upon the acceptance in principle by the Secretary of State for the Colonies of three recommendations: first, that a Committee for Colonial Agricultural, Animal Health and Forestry Research should be established; second, that a Colonial Research Service should be set up; and third, that agricultural research in the Colonies should be organized as far as possible on a regional basis.

The first step, the establishment of the Research Committee, having been duly taken, the present report provides from this Committee a statement of the policy upon which its recommendations will be based, mainly with reference to the proposed research service and its regional organization.

The Committee has adopted three general principles for its own guidance. The first of these is: *That agricultural research shall be so organized and so maintained that it shall play its full part in providing the knowledge upon which agricultural improvement can be based.*

A primary essential for the application of this principle is the conduct of basic surveys of available physical resources and conditions, and of agricultural systems and populations. At the same time provision must be made for direct research on agricultural problems, divisible, though without any well defined boundaries, into applied and basic or even fundamental research. Here the Committee makes a deliberate deviation from the policy laid down by the Imperial Agricultural Conference of 1927 for regional research, believing that the direction then given, for concentration on " long range " and " wide range " research, tended in the event to dissociate the organization from close contact with the agriculture of the region. The Committee has no wish to exclude research of this type, but considers that the research programme should provide for both types and maintain a proper balance between them. Basic research will be required to deal with deficiencies in knowledge encountered in the course of work on applied problems, and will thus be linked with the practical needs of the region concerned.

The report next deals with the conditions essential for the development of the full capacity of the individual research worker, upon whom, in the last resort, the efficiency of the organization depends. These include salaries comparable with those of the Scientific Service in the United Kingdom with suitable adjustments to bring them into line with officers of similar status in the Colonial Services. A transferable superannuation scheme will permit of movement into or out of the Service at any stage without loss of benefits. It is the intention to supplement the officers who wish to make a continuing career in the Colonies with others of more mature experience prepared to serve for limited periods overseas, and also to facilitate transfer from other Colonial appointments. It is considered that the grouping of research workers into a regional organization will reduce the effects of isolation which have been a serious bar to efficiency in officers scattered in territorial stations. Within the general lines of the research programme a reasonable freedom should be allowed to the

individual to follow his own line, and even, in exceptional circumstances, to pursue his object beyond the limits assigned. Although provision may be made for advice as to the selection of problems to come from outside, the planning of research should be left mainly to the research workers themselves. Lastly, emphasis is given to the necessity, besides adequate scientific equipment, for satisfactory provision for housing, health and recreation.

The second and third of the general principles enunciated are the following: *That the organization of agricultural research shall be such that the resulting knowledge obtained flows freely to those who will apply it to practice or will convey it effectively to those who will apply it;* and *That agricultural research shall be so organized that it is accepted as an essential and continuing activity in Colonial communities.*

In a discussion of regional organization the Committee recognizes that construction cannot be other than a gradual process. Two existing organizations date back to the proposals for a similar comprehensive scheme adopted by the 1927 Conference, namely the East African Research Institute based on Amani, and the research schemes for the West Indies centred on the Imperial College of Tropical Agriculture in Trinidad. Since 1941 steps have been taken towards grouping veterinary research in East Africa. Future possible regional groupings are the West African colonies and Malaya, Sarawak, and North Borneo. On the question (a vexed one in many or most colonies) as to the degree of fusion practicable in the provision for research in Agriculture, Forestry and Animal Health, the Committee expresses no definite opinion, beyond emphasizing the desirability of the utmost possible collaboration.

In order to ensure that a close relation with regional institutions and industries is maintained the report recommends the establishment of a standing Advisory Council representative of the Departments concerned, of producers, directors of research, including those of Commodity Research Stations, and senior research officers. Its functions would include consideration of the needs for research in any direction, the discussion of research programmes framed by the directors, and advice on the means for ensuring the application of results obtained.

In considering the form and constitution of a regional research organization the Committee recommends that the director should have independent charge and be directly responsible to the appropriate authority in the region, while free to correspond directly with the London Committee. The organization should have a Headquarters Division for administrative and common services, and appropriate Science Divisions. The latter should not, however, work in isolation; members must be available for co-operation in team work as required.

On the critical question of the relation of the Research Organization to the territorial departments the Committee recognizes the need for a clear definition of responsibilities. Where the Departments have up to the present maintained a specialist staff for research purposes it is proposed that this should be transferred, so far as it is not an essential part of the departmental machine, to the Research Organization. On the other hand the Departments will continue to require specialists to administer control legislation and to provide analytical, diagnostic and advisory services; it is moreover recognized that such officers are

often qualified and able to contribute to the advance of research in the course of or incidental to their primary duties. The Departments from their association with practice will generally be the first to recognize outstanding problems, and best able to judge their relative urgency. It will be their responsibility to bring them to the notice of the Research Organization, and of the latter to give them the fullest consideration.

To ensure the continuity that is the purpose expressed in the third of the stated principles it is considered essential that the responsibility of the Governments and people of a Colonial region for establishing and maintaining research organizations be clearly recognized. This rules out any approach to a central establishment, financed from Imperial funds, administered and directed from London.

A section of the report which will have special interest for many readers of this Review deals with the relation of the Research organizations to Commodity Research Stations, such as the Cotton Research Station in Uganda, whose finances are provided wholly or in part by producing or consuming industries. Their governing bodies are invited to consider the advantages likely to accrue from a close liaison with the official organization. In return for the recommendation that the directors should be invited to serve on the Regional Advisory Council the suggestion is made that the Director of Research might be co-opted on to the governing body of the stations concerned. "Furthermore, we believe that the Commodity Station might often find it convenient to come to an arrangement for the Research Organization to second to it research staff for prosecuting particular enquiries. We should welcome developments that led to a free movement of officers from the Research Organization into and out of the Commodity Station, as the problems requiring attention changed in their nature and emphasis. The work of the Commodity Station, which must necessarily be of an applied character, will often reveal problems requiring basic research for their solution. We should welcome requests from the authorities of the Station for such work to be undertaken by the Organization, if, as will often happen, its equipment and more varied staff place it in a better position to prosecute efficiently the required research."

It will be seen from this summary of the Report that it deals with matters of the highest possible importance to Colonial Agriculture, and that it meets on certain points the need for information indicated in the April number of this Review. Of the principles and policy laid down much is beyond question; discussion of the more controversial questions involved is reserved to a later opportunity.

THE "AGROCIDE" RANGE OF INSECTICIDES BASED ON GAMMEXANE. (Plant Protection Ltd., Nobel House, London, S.W.1.) The value of Gammexane as an insecticide is by now well known in general terms, but the forms in which it is available for the protection of agricultural and horticultural crops are less familiar, and their specific application to a world-wide range of plant pests is for the most part only beginning to be worked out. The remarkably well-produced pamphlet under review supplies information which will be welcome to very many

at home and overseas. The range of preparations includes special dusts for low-growing crops, for pests in the soil, and for general purpose use on fruit, farm and plantation crops. For spraying Gammexane is available as a fluid in an organic solvent or as wettable powder, while another form is designed for mixing with suitable material to prepare poison baits.

The pamphlet includes an approximation to a cosmopolitan list of important pests concerning which there is more or less evidence of the usefulness of the preparations listed. Trials of Gammexane on cotton plant pests are still in the early stages, but effective results have been reported from the U.S.A. (*vide* Abstracts 351, 352, 354 and 357 in this issue).

EMPIRE COTTON CROPS FOR THE YEARS 1937–1947

(In bales of 400 lbs.)

The seasons are given as covering two years (*e.g.*, 1936–1937) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (*e.g.*, Tanganyika, Cyprus, Malta and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should read as relating to the crop grown and harvested in the latter of the two years at the head of the column.

COUNTRY.	1936–37.	1937–38.	1938–39.	1939–40.	1940–41.	1941–42.	1942–43.	1943–44.	1944–45.	1945–46.	1946–47.	
(1) Anglo-Egyptian Sudan	332,687	331,639	331,104	292,706	319,682	295,107	354,109	222,877	374,296	242,343	282,387	(1)
(2) Uganda	338,391	417,179	303,893	296,672	368,898	236,370	112,849	191,870	272,064	228,709	231,678	(2)
(3) Kenya	22,166	19,610	9,976	11,622	15,094	12,269	5,453	6,330	5,384	5,015	5,148	(3)
(4) Tanganyika ..	61,783	44,636	64,106	65,314	72,766	51,017	38,309	24,797	40,421	41,028	39,963	(4)
(5) Nyasaland ..	13,908	17,358	5,276	6,526	5,376	14,392	5,552	8,450	8,302	9,050	11,166	(5)
(6) N. Rhodesia ..	—	43	77	68	78	75	39	20	23	36	4	(6)
(7) S. Rhodesia ..	530	338	82	408	433	1,938	1,464	1,657	1,227	870	434	(7)
(8) Union of South Africa and Swaziland	3,397	1,132	747	2,061	1,857	854	584	664	338	340	1,113	(8)
(9) Nigeria*	47,554	31,636	24,057	50,632	73,295	36,119	32,494	24,618	15,803	36,602	34,175	(9)
(10) Gold Coast ..	145	4	5	6	17	20	30	137	—	168	168	(10)
(11) Cyprus	4,670	2,151	1,705	1,735	722	1,589	1,661	1,341	2,380	1,900	2,000	(11)
(12) Malta	32	26	28	27	—	—	—	—	—	—	—	(12)
(13) Ceylon	369	355	196	261	452	430	46	107	10	31	40	(13)
(14) Queensland ..	10,649	11,935	15,457	10,319	14,296	12,312	8,364	7,366	1,627	2,847	1,906	(14)
(15) Fiji	65	60	7	45	38	—	—	—	—	—	—	(15)
(16) West Indies ..	4,676	6,196	5,636	8,492	9,312	7,450	4,555	4,099	4,525	3,762	2,573	(16)
	841,022	884,298	762,352	746,894	882,316	669,942	565,509	494,333	726,400	572,701	612,755	
		Percentage Increase 5·1	*Percentage Decrease* 13·8	*Percentage Decrease* 2·3	*Percentage Increase* 18·1	*Percentage Decrease* 24·0	*Percentage Decrease* 15·6	*Percentage Decrease* 12·6	*Percentage Increase* 46·9	*Percentage Decrease* 2·1	*Percentage Increase* 7.0	

* *Exports only.*

NOTES ON CURRENT LITERATURE

COTTON IN INDIA AND IN PAKISTAN

297. Cotton in India: The Problems of Partition. (*Man. Guar.*, 20/5/48.) Partition has had a curious effect on the cotton industry of India and Pakistan. In general, India is heavily dependent on Pakistan for the bulk of her supplies of medium and long-staple raw cotton; the position is reversed in the case of cloth. With Japan's entry into the war at the end of 1941, India found herself with enormous unsaleable stocks of short-staple cotton of which Japan was the biggest consumer in the pre-war period. Driven by an acute shortage of food after the fall of Burma and Malaya (her normal suppliers of coarse rice), India switched over from cotton to food crops, with the result that the total area under cotton, which was 24,000,000 acres on the eve of the war, dropped to 14,500,000 acres in 1945-46. This was the general picture for India as a whole, before partition had become a serious demand. Western Punjab in her canal areas had specialised in American long-staple cotton, gradually abandoning indigenous varieties. In 1945-46, of nearly 3,000,000 acres under cotton, two-thirds were under American cotton, producing 1,200,000 bales, or 31 per cent. of the total cotton crop of the country. In Sind (another Pakistan province) striking progress has been made in cotton research, and a superior strain has been evolved with a staple length of over 1 in. and a better ginning capacity than any other variety grown in India. The yield, also, is the highest in the country, averaging 200 to 220 lb. of lint per acre.

Pakistan's own capacity for the consumption of her cotton is extremely limited, there being only about half a dozen textile mills of any importance. Before partition, Indian mills imported on an average well over 1,000,000 bales of medium and long-staple cotton from the Pakistan zone. It is considered probable that there will be a demand for Pakistan cotton from Europe and the United Kingdom, and to some extent from China. Already, with the recent relaxation of export restrictions on cotton, Belgium, China, Britain, and Australia have entered the market.

298. Indian Central Cotton Committee. (*Ann. Rpt.* 1945-46. Received 1947.) In the twenty-fifth annual report it is stated that good progress was maintained in the various spheres of the Committee's activities. Twenty-five research and nineteen seed multiplication and distribution schemes, mainly financed by the Committee, were in operation. Progress was continued in the introduction of improved varieties of cotton in twelve Provinces and States. The various Acts passed for the regulation of transport, marketing, ginning and pressing of cotton, and the prevention of the introduction of various cotton pests, functioned satisfactorily throughout the season. At the Institute of Plant Industry, Indore, work in connection with cotton genetics and plant breeding and physiology was continued. The cotton research and testing activities of the Technological Laboratory at Matunga were maintained at the standard of previous years.

299. Cotton Improvement in the Bombay Karnatak. By A. S. Patil. (*Ind. Cott. Grwg. Rev.*, 11, 1, 1948, p. 31.) Deals briefly with the evolution of the Jayawant and Gadag No. 1 cotton varieties, and their distribution and extension in the Bombay Karnatak.

300. Comparative Tests on Standard and Trade Varieties of Indian Cottons. By V. Venkataraman. (*Ind. Cott. Grwg. Rev.*, 11, 1, 1948, p. 25.) Comparative mean results over a number of seasons for 11 varieties of standard and trade cottons in respect of waste losses and yarn-strength are tabulated; the individual results for each season are not tabulated. In most cases the trade varieties sustained

higher waste losses, especially in the blowroom, than the respective standard cottons. Sind Sudhar was an exception. The card losses might be expected to be somewhat higher for the trade than for the standard variety in view of the fact that the former is pressed in bale while the latter is supplied in loose condition.

301. Dyeing Properties of Indian Cottons. By D. L. Sen and N. Ahmad. (*Tech. Bull. Ser. B. No.* 27., Ind. Cent. Cott. Comm., 1947.) The results are given of experiments carried out to test the behaviour of twelve Indian cottons towards five important substantive dyes of varying molecular weights.

COTTON IN THE EMPIRE

302. British Cotton Growing Association. The forty-third annual report of the Association, to December 31, 1947, states that while it is gratifying to be able to record an increased production in 1947 of approximately 40,000 bales above that in 1946, this is due mainly to the Anglo-Egyptian Sudan. Production in the Sudan has been comparatively consistent, and this season it was at least equal to its pre-war average. There was a decrease in production in Uganda, Nigeria, and Tanganyika, and it will be seen that anticipations of a fairly early post-war expansion of cotton growing, even to the pre-war figures, are not being fulfilled, despite the necessity and growing urgency of this country for cotton from non-dollar areas. The Sudan can be expected to at least maintain its production of Sakel, and as soon as the food position allows, increase the cultivation of American-type rain-grown cotton. In Uganda, war-time conditions necessitated the extended cultivation of grain, oil seeds, flax, and tobacco as cash crops. These will continue to be grown to some extent, as well as coffee—Uganda is now the greatest coffee-producing country in the Empire—and while cotton, therefore, is not expected to regain its pre-eminence, it is the Uganda Government's intention to aim at crops of 400,000 bales. Tanganyika, also, should be able to regain its position, while in Nigeria the necessity of much larger supplies of cotton for export has been brought to the attention of that government. Apart from the Anglo-Egyptian Sudan, cotton in Africa is essentially a peasant crop, and it is to the peasant farmers in the areas which produced some fairly substantial crops in pre-war years that one has first to look to regain the position and expand raw cotton supplies. In all these countries there are two very necessary services that require improvement and strengthening—viz., transport and agricultural staff. The need for improved transport services—road and rail—applies more or less to all producing countries, particularly to Nigeria, where the bales of the 1947 cotton crop had to be stored for an average period of eight to nine months before railing facilities to the coast were available, and cotton seed, which is today a valuable product, had to remain in store for fully twelve months. Equally important is the necessity of bringing the now very attenuated Agricultural Departments up to full strength. Cotton as an important cash crop of the peasant farmer must fit in with a consistent production policy, and it is to the officers of the Agricultural Departments that the grower looks for guidance.

303. AFRICA. Kenya Colony. Cotton Industry 1945-47. (*Ann. Rpt. Dpt. Agr.*, 1946. Received 1948.) The cotton industry remained depressed owing to the need for concentration on the production of cereals and oil seeds. A somewhat larger acreage was sown in Nyanza, and the variety N.17 was discarded in favour of BP.52. Early growth was satisfactory but boll shedding was severe later, and the yield was only 10 bales more than in the previous season. The price to the grower was 17 cents per pound first grade seed cotton. On the Coast the crop amounted to only 695 bales, compared with 1,095 bales in 1944-45; the price to the grower was 18 cents per pound.

As a result of the poor 1945-46 crop there was considerable reluctance to open up new ground in Nyanza for 1946-47, but with a favourable season a slightly increased yield was expected. The 1946-47 season on the Coast promised to be the best on record. Considerable damage to cotton in Nyanza was caused in 1945-46 by *Lygus*

and stainers; blackarm injury was variable, generally following in the path of hail-storms, which visited all areas.

304. NIGERIA: COTTON PROSPECTS, 1948-49. (*Overseas Rev.*, Barclays Bank, April, 1948, p. 20.) In Nigeria cotton seed is not being disposed of to the same extent as in previous years—considerable areas of land formerly planted with cotton having been given over to groundnut cultivation. It is not expected that any improvement in production can be looked for unless price increases are announced next season.

305. NYASALAND: COTTON PROSPECTS, 1948. The report of the Department of Agriculture for April states that in the Lower Shire district weather has been ideal, growth excellent, and bollworm incidence low, and the prospects of a record crop still hold. Elsewhere progress is also satisfactory, but although the estimate in the Central Province (400 tons) is 30 per cent. better than last year, it is not as high as had been hoped. Seed issue for the Karonga winter crop is about to commence.

306. SOUTHERN RHODESIA: COTTON INDUSTRY, 1946-47. (*Ann. Rpt. Cott. Res. and Indus. Bd.*, 1946-47. Received 1948.) The 1946-47 season will be remembered as the worst in memory, on account of the severe drought conditions which prevailed. Many farmers were unable to plant cotton at all, and the few who did obtained poor stands. Such cotton, however, as did survive the drought promised to be of good quality, and a high percentage of first-class cotton was received from Matabeleland and the Midlands. The changing economic conditions of the country, and the increased demand for African labour for more remunerative crops than cotton, coupled with industrialization, make it imperative to review the outlook for Rhodesian-grown cotton in the future. Many farmers would grow larger acreages of cotton but for the shortage of labour at harvest time. Similar conditions prevail in certain parts of the United States, and large cotton growers are compelled to use mechanical cotton pickers. These have now been brought up to a high stage of perfection, and while they do not reap the cotton in as clean a condition as handpicked cotton, it is claimed that they are speedier and more economical. Visitors who have seen mechanical picking in the United States have remarked on what appears to be the suitability for mechanical picking of the type of cotton grown in Southern Rhodesia. The plants are small, compact, and, owing to early leaf-fall in the autumn, the crop would not require special treatment to bring about defoliation, as is sometimes required before picking by machine in the United States. An International cotton picking combination is on order from America, and when this is obtained it will be given a thorough trial at Gatooma. If successful, the Board contemplates the purchase of a number of these machines, provided there is sufficient increase in acreage to justify doing so. There are stretches of virgin land between Bulawayo and the Victoria Falls which, so far, have not been developed, and it is possible that by using composted cotton as a pioneer crop, much of the land could be brought into cultivation.

307. COTTON RESEARCH STATION, GATOOMA: PROGRESS REPORT FOR THE SEASON 1946-47. By A. H. McKinstry. (*Prog. Rpts. from Exp. Sta.*, 1946-47.) Drought conditions dominated the 1946-47 season. The Gatooma area was representative of an intermediate zone, to the north and east of which rainfall was better, but to the south and west of which large areas suffered crop failures. Drought conditions throughout the season served once again to emphasize the drought-tolerant qualities of the cotton crop as compared with maize. Sudan bollworm was the only pest of importance on the Station. The attack by this pest lasted throughout the life of the plants, and, in general, was heavy. Where attack and damage by the bollworm was least severe, yields ranged from 450-600 pounds of seed cotton to the acre, despite drought conditions. The main investigations connected with increasing yields per acre are aimed at the control of Sudan and American bollworms. An account is given of the work in progress. Yield returns from the Main Variety Trial confirm those of the previous season, that derivatives of the 7Cs (Gatooma U4 × Cambodia) × U4 are as good as, or possibly better than, 9L34, the strain at present in commercial cultivation and a descendant of the original U4 material. A number

of Barberton strains, also derived from U4 × Cambodia crosses, were grown in trials for the first time this season at Gatooma and yielded well. Several grasses under observation in small plots during the past two seasons show definite promise of being an improvement on local indigenous types under rain-grown conditions.

308. First Interim Report of the Development Co-ordinating Commission. (Pubd. by Govt. Stat. Off., Salisbury, 1948. Price 1s.) *Textiles and Cotton Piece Goods.* Economical production of textiles is of peculiar importance in Central Africa. The provision of native wear—shirts, vests, and the like—at attractive prices and of good wearing quality, creates an incentive to effort by native labour in the shape of a tangible return for money earned. The policy of starting a State-operated yarn-spinning mill at Gatooma backed by a Cotton Research establishment has already proved sound. The boundary between State enterprise and private fabrication has at present been fixed at the stage of yarn spinning. Secondary industries have been actively developed, and a stage has now been reached, due to unco-ordinated importations of knitting and weaving machinery, when the demand for yarn from the Gatooma mills is very greatly in excess of available supply. This deficiency has been emphasized by the dollar stringency, which prevents yarn from being imported from America. It has also been affected by the disinclination of British mills to export the coarser types, and by the fact that the Gatooma product is considerably cheaper than imported yarn. The requirement of the moment is in the neighbourhood of 90,000 lb. of yarn a week. The output is only 20,000 lb. a week. The initial installation of 1,066 spindles has been increased to 8,000. It is assessed that there is a future Central African outlet for the production of 100,000 spindles. Spinning capacity of this order needs backing by increased cotton growing. Disappointments sustained by previous cotton growers have prevented expanded activities heretofore, but the establishment by the Cotton Research Board of a successful rotation of cotton, maize, sunnhemp, maize should go far to remove this disinclination. . . . The Commission recommend that an active campaign be undertaken under the auspices of the Cotton Research and Industry Board to foster and popularize the growing of cotton by natives; to increase the capacity of the Gatooma Mills to 100,000 spindles; to maintain active research into the improvement of the quality of the yarn from Gatooma parallel with its production in the weights necessary to fulfil the requirements of the private enterprise secondary industries that have been, and are likely to be, established in the Colony.

309. South Africa: Cotton Industry, 1947-48. (*Cott. and Genl. Econ. Rev.*, 15/4/48.) The big advance in raw cotton prices over the past twelve months and the growing demand from the domestic mill industry have influenced farmers to plant an appreciably larger acreage to cotton than last year. If growing conditions are favourable the current crop should be considerably greater than the small 1947 crop of 890 bales.

310. Cotton Growing in the Sudan. By M. Afzal. (*Ind. Cott. Grwg. Review*, 11, 1, 1948, p. 1.) A brief account of the subject dealing with climate; crops other than cotton; soil of the Gezira Plain; Egyptian cotton in the Gezira, Gash Delta, and Tokar, and American cotton in Kordofan and Equatoria; seed supply.

311. La Culture du Coton au Soudan Anglo-Egyptien. By T. Trought. (*Coton et Fibres Trop*, 2, 1947, p. 67.) A brief review is given of the history of cotton cultivation in the Anglo-Egyptian Sudan, and of conditions ruling in the four principal cotton-growing regions, the Gezira, Gash Delta, Tokar, and the Nuba Mountains. The organization of cotton cultivation and of the markets in the Gezira are described. It is pointed out that the development of cotton cultivation in new regions cannot be undertaken without the provision of a sufficient number of trained scientists, well-equipped experiment stations, and testing fields.

312. Tanganyika Territory: Cotton Industry, 1945. (*Ann. Rpt. Dpt. Agr.*, 1945. Received 1948.) The adverse climatic conditions experienced resulted in short food crops and a below-normal cotton crop in the areas of the Eastern, Southern, Tanga, and Western Provinces in which cotton is cultivated. The Lake

Province, except for Bukoba which had a normal season, suffered more than the rest of the Territory, and only a fair cotton crop was produced. Damage to the crop was caused by various pests, including *Heliothis armigera, Helopeltis bergrothi*, leafroller, locusts, *Lygus*, pink bollworm, and stainers. Fairly extensive damage to cotton was also caused in the Eastern, Southern, and Tanga Provinces by an epidemic of the grey field mouse. The main cotton experimental work was carried out by the scientific officers posted in the country by the Empire Cotton Growing Corporation. Cotton breeding work was chiefly directed to evolving varieties with good jassid resistance and also a fair degree of blackarm resistance.

313. Cotton Prospects, 1948. A report from the Department of Agriculture for March states that the protracted dry weather conditions since January in most parts of the Territory ceased during the month and good rains fell everywhere. In the Northern Province, however, the good rains experienced early in the month ceased later, and since mid-month dry weather has prevailed, causing a setback to planting and newly planted crops. Rain has been fitful in the Tanga Province, and much of the hill areas has had scattered showers only. In the Eastern Province it was not until after the twentieth that rain fell in appreciable quantity.

Big efforts are being made in the Eastern Province to make up for lost time caused by the drought period. Applications for cotton seed have increased over previous years. The rains early in March stimulated planting in the Moshi and Arusha districts, but their early cessation caused a serious setback in planting. Planting in the Shinyanga district was continued during the month. Rain is still required in all Lake Province cotton areas. Flowering of the early planted crop is taking place in Maswa. Satisfactory progress with land preparation in the Eastern Province has been made, but somewhat late planting, which has now begun, will be general owing to the lateness of the rains. Increased seed takings by native growers indicate that a larger area will be planted than in previous years. The Northern and Tanga crops have been harvested, and ginning is almost complete.

314. Uganda: Cotton Industry, 1945-46. (*Ann. Rpt. Dpt. Agr.*, 1945-46. Received 1948.) Data on cotton production during the season in the Western, Buganda, and Eastern Provinces are tabulated, and seed distributions for the 1946-47 season are recorded. Adverse weather conditions were experienced during 1945-46, and considerable damage to the cotton crops was caused by blackarm and *Lygus*.

315. Cotton Prospects, 1947-48. The report from the Department of Agriculture for the month of April states that marketing was completed and total purchases approximated to 166,000 bales. Preparations for the new crop were held up by unfavourable weather, but nevertheless it is anticipated that the response to early planting propaganda will be good. Cotton seed distribution proceeded satisfactorily, and the demand for seed has been keen. The replacement of B.P.52 seed to Masaka from Mengo District has started.

316. Cotton Prices, 1948-49. (*Overseas Rev.*, Barclays Bank, April, 1948, p. 14.) The price to be paid to the grower for next season's crop is to be increased to approximately 30 cents per lb. A bonus of 1s. per 100 lb. is also to be paid to the local Native Administrations, who it is hoped will be encouraged to exert more direct pressure on the grower.

317. Problems of the Uganda Cotton Industry. By W. W. Higgin. (*E. Afr. and Rhod.*, 1/4/48.) Over 50 per cent. of the Uganda cotton crop has in normal years been grown in the Buganda Province, but competition from other crops giving a better economic return is tending to reduce the acreage under cotton. As a result of increased competition for labour for native-grown coffee and plantation crops, the low-paid migrant labour from the Belgian Congo, on which the Baganda had relied to cultivate and pick his cotton, is neither so plentiful nor so cheap. It would appear that the prospect of increasing cotton production in Buganda depends upon the introduction of more up-to-date agricultural methods. The factors necessary for obtaining high yields are early ploughing, early planting of good seed, correct spacing,

proper weeding, complete crop picking, and proper crop rotation. The Administration, the Department of Agriculture, and the staff of the experimental stations in Uganda are agreed on the main lines of the solution of the problem of increased and better cotton production. The difficulty appears to lie in its practical application. This can be achieved only by a greatly augmented staff and by determination on the part of the Administration to cut through difficulties.

318. MECHANIZED AGRICULTURE. (*Crown Col.*, April, 1948, p. 217.) Light agricultural machinery has been obtained for experimental use by individual African farmers and by small groups. In addition, heavy machinery has been purchased with the object of investigating the possibilities of mechanical cultivation by Africans on the wider basis of communal and co-operative cultivation in the interests of better and more economic farming. As the economic use of heavy implements requires the re-organization of cultivation into some form of strip cropping, mechanical cultivation, if proved practicable, will not only assist in increasing production, but will go a long way towards solving the problems of soil conservation.

319. AUSTRALASIA. QUEENSLAND COTTON INDUSTRY, 1946-47. (*Queens. Agr. J.*, 65, 6, 1947, p. 366.) Weather conditions during the season were not conducive to successful cotton growing, and many crops were checked to such an extent that when the abundant February rains occurred they were unable to respond, and did not fully recover. The cotton acreage for the season was again small, though seed applications showed an appreciable increase over the previous year. In many cotton-growing areas, sufficient moisture to prepare the seed-beds and to plant cotton was not available until late November and December, which resulted in a reduction of acreage. From past experience, it would appear that the best results are obtained from October plantings.

320. WEST INDIES. PEASANT AGRICULTURE IN BARBADOS. By M. Halcrow and J. M. Cave. (*Bull.* 11. n.s. Dpt. of Sci. and Agr., 1947.) *Sea Island Cotton:* The sudden improvement in the level of production in 1946-47 coincided with very dry conditions, which evidently suited the crop. Yields up to 1,200 lb. seed cotton per acre were recorded from individual farms. The higher yields were attributed partly to an increase in the use of fertilizers which was practically impossible during the war years, and also, earlier planting might be a factor. Peasant production in 1946-47 represented 81 per cent. of the Island's total production; there were only 18·5 acres of estates' cotton with an average yield of 530 lb. seed cotton per acre.

The cotton crop is sold by the growers themselves direct to the only ginnery in the Island, the Barbados Co-operative Cotton Factory, in Bridgetown. This arrangement suffices while the Island's crop is so small, but if the area planted to cotton be increased, arrangements for buying the crop in the districts could no doubt be made. Under the Sale of Cotton Act, 1906, growers have to obtain a licence from the Vestry of the parish concerned before cotton can be sold.

COTTON IN THE U.S.A.

321. AMERICAN COTTON CROP, SEASON 1947-48. (*Cotton*, M/c., 8/5/48.) The grade of the 1947 cotton crop was the highest since 1939, and considerably higher than that of the small 1946 crop. However, the staple length averaged somewhat shorter than the 1946 crop, according to a report recently released by the United States Department of Agriculture. The higher grade of the cotton ginned in 1947 is the result of generally favourable weather for harvesting throughout most of the Cotton Belt. The grade index of the 1947 crop is estimated to be 96·9 (Middling White equals 100) as compared with 94·6 for the 1946 crop. The grade was higher in all the major cotton-producing States with the exception of North Carolina and South Carolina, where unfavourable weather and competition of other crops delayed harvesting. The greatest improvement occurred in the Mississippi Valley area, in Texas, Oklahoma, and California. The shorter average staple length of the 1947 crop is attributed to (1) dry weather during July and August in most of the

Mississippi Valley area; and (2) sharply increased cotton production in western Oklahoma and north-west Texas, where relatively large proportions of shorter staple cotton are grown. The average staple length of cotton produced in 1947 was estimated at 31·7 thirty-seconds of an inch compared with 32·6 thirty-seconds in 1946. With respect to staple length the outstanding features of the 1947 cotton crop compared with 1946 are: (1) decrease in average length; (2) increase in proportion of crop measuring $\frac{15}{16}$ in. and shorter, and particularly $\frac{7}{8}$ in. and $\frac{13}{16}$ in. and shorter; (3) increased proportions of $\frac{31}{32}$ in. and 1 in. cotton; and (4) sharp decline in proportion of $1\frac{1}{16}$ in. and longer. During 1947-48 ginnings in the United States totalled 11,548,900 bales, or about 36 per cent. more than was ginned from the previous crop. On August 1, 1947, the cotton carry-over totalled 2,530,000 bales. This, plus ginnings, brings the total cotton supply for the 1947-48 season to 14,079,000 bales.

322. AMERICA: COTTON PROSPECTS, 1948-49. (*Cott. and Genl. Econ. Rev.*, 14/5/48.) Weather in the Southern cotton belt has continued favourable to the start of the new crop. Germination is reported satisfactory in the more southerly districts. The acreage increase for the belt is estimated at about 10 per cent. over last year's area.

323. "MARSHALL PLAN" COTTON FOR EUROPE. (*The Ambassador*, March, 1948, p. 141.) Shipments of cotton from the United States to the textile mills of Europe under the Marshall Plan are expected to total more than 10 million bales in the four-and-a-quarter-year period, stated the American Secretary of State recently, when he addressed members of the U.S. National Cotton Council at Atlanta, Georgia. During the first fifteen months of the Plan (April 1, 1948 to July 1, 1949) shipments are planned to total 3 million bales; the volume of cotton to be supplied by other countries in the Western Hemisphere will be about half the U.S. total. Since the high domestic demand, coupled with a comparatively small crop in 1947, has reduced U.S. stocks of cotton to a minimum level of safety, allocations of American cotton to mills at home will have to be limited accordingly. Mr. Marshall went on to point out how vital would be the supply of U.S. cotton to the textile industries of Europe. The manufacture of textiles is one of the principal industries in Europe, employing many hundreds of thousands of people; the operations of this industry were drastically curtailed during the war; plant maintenance was neglected, and machinery deteriorated and fell into disrepair; new machinery and spare parts were still hard to obtain because of a severe shortage of steel and machine tools. But the principal difficulty which lies ahead of the industry is the necessity to import cotton and other raw materials at heavy cost in foreign exchange, principally dollars. If prompt assistance is not afforded by the United States, Western Europe will be unable to continue to import the necessary cotton and other raw materials for the textile industry. Moreover, Europe is not only called upon to clothe its own expanded population; it must greatly increase textile production for export, in order to earn money to pay for food and other imports it lacks. The U.S. South has made progress in recent years, through diversification and industrialization, towards eliminating the adverse effects of a one-crop economy; but cotton still remains the principal cash crop of the South. The South therefore has a vital part to play in providing this essential commodity in sufficient volume to meet the home demand, whilst leaving a surplus available for European recovery.

324. AMERICAN CO-OPERATIVE TEXTILE RESEARCH ORGANIZATIONS. By W. A. Newell. (*Text. World*, 97, 10, 1947, pp. 101, 192. From *J. Text. Inst.*, xxxix, 3, 1948, A178.) An account is given of the aims and functions of the Textile Research Institute, the Textile Foundation and the textile laboratories of Princeton University, liberally illustrated with photographs. Mention is made of apparatus and equipment in use and under construction, and an outline is given of research projects, especially those on infra-red drying, mechanical properties of fibres and the effect of moisture.

325. TRACING AMERICAN CULTIVATED COTTONS. See Abstract 380.

326. SOUTH CAROLINA: COTTON PRODUCTION AND BOLL WEEVIL CONTROL, 1948. By H. G. Boylston *et al.* (*Circ.* 310, Clemson Agr. Coll. and U.S. Dpt. Agr., 1948.)

Deals with the subject under the following headings: Varieties and Planting Seed; Soils and Preparation; Fertilization; Planting; Cultivation; Cotton Insect Control in 1948:—Insecticides; guidance in early season control; midseason control; protection of young bolls during migration period; combination control of several cotton insects. Harvesting and Ginning.

327. TEXAS: COTTON FOR MECHANICAL HARVESTING. (*59th Ann. Rpt. Texas Agr. Exp. Sta.*, 1947. Received 1948.) Increasing interest has been taken in recent years in the mechanical harvesting of cotton in West Texas, particularly in the High Plains, and breeding experiments have been carried out for some years at the Lubbock and Chillicothe stations to combine in synthetic hybrid types characteristics such as storm-proofness, a more determinate fruiting habit and earliness in maturity, combined with high yield of a quality of lint which will clean out well at the gin, and possess good spinning properties. Three promising hybrid strains, C.A. 89A, A.A.122, and Storm-proof No. 1 were developed during 1945 and 1946. Seed of these stocks has been released to State certified cotton seed breeders, who are increasing the seed supply to fill the demand for such cotton for planting in a large area in West Texas especially suited to mechanized production.

328. LOWER RIO GRANDE VALLEY COTTON. (*59th Ann. Rpt. Texas Agr. Exp. Sta.*, 1946.) Results of experiments conducted at the Weslaco Station during the past five years show that it is possible to produce yields of $1\frac{1}{16}$ in. to $1\frac{1}{8}$ in. cotton ranging around two bales per acre. Wilds cotton having a length of $1\frac{1}{2}$ in. will produce yields ranging around $1\frac{1}{2}$ bales per acre when grown under irrigation in the delta region of the Lower Rio Grande Valley. Cotton produced under irrigation and defoliated just prior to picking has spinning quality equal to the better types of American Upland cotton grown under more humid conditions.

COTTON IN EGYPT

329. EGYPT: COTTON PROSPECTS, 1948. (*Cotton*, M/c., 15/5/48.) In Upper Egypt the new crop is now progressing favourably, but in Lower Egypt the continued variable weather gives further cause for anxiety. The crop is some twenty-five to thirty days late, and it is therefore essential that extremely good weather conditions are now experienced to strengthen and hurry on the young plants and enable them to resist the various diseases and insect pests which will shortly commence to attack them.

330. EXPORT TAX. (*Overseas Rev.*, Barclays Bank, April, 1948. p. 16.) On April 11 the Egyptian Government announced the imposition of an Export Tax equivalent to $2\frac{1}{2}$d. per lb., applicable with immediate effect on all cotton to be exported from the country. Despite protests from the Exporters' Association, the Government ruled that the new tax was applicable to sales already made on the usual F.O.B. and C.I.F. terms, and it is, therefore, a direct charge on exporters who have made such sales. New terms of sales are likely to include a provision that foreign buyers will be responsible for any amendments that may be made by the Egyptian Government to the Export Tax. The Government state that the new tax was required to provide funds for subsidizing the local spinning industry so as to prevent an increase in the controlled retail price of manufactured cotton goods.

331. EGYPTIAN COTTON: THE VARIETY PATTERN FOR 1948. By C. H. Brown. (*Egyptian Cott. Gaz.*, iii, 1, 1948, p. 69.) Menufi cotton is generally considered less neppy than Karnak, and it can be taken for granted that all available seed will be used for sowing. This also applies to the new types Giza 30 and Giza 23. The former is already extremely popular with growers, with ginners—as a result both of its high ginning yield and high average grade—and apparently also with those few spinners who have got to know it. The 1947 area of 22,285 feddans should expand to between 100,000 and 120,000 feddans in 1948. It will thus be seen that the approaching season brings Giza 30 to the forefront as a major Egyptian variety. It is also of some interest to mention that the new nucleus family now selected for Giza 30 has a yield apparently about 7 per cent. higher than the existing bulk, and should

in future still further strengthen the competitive position of this most attractive cotton. A much smaller area, about 20,000 feddans, will be grown with Giza 23, but here again growers seem to have had satisfactory results, and it is certain that this variety will be preferred to Zagora by those able to obtain seed.

332. The Egyptian Cotton Gazette. The contents of Vol. 3, No. 1, 1948, include the following articles: "The Alexandria Testing House"; "The Case for Establishment of Universal Egyptian Cotton Standards" (D. Windel); "Trading on Shippers' Individual Types—Advantages to the Consumer" (C. M. Ralli); "The Variety Pattern for 1948" (C. H. Brown); "Note on the State of the French Cotton Industry"; "European Recovery and American Aid"; "The Position of Egyptian Cotton at December 31, 1947" (R. Dabbous). Various statistical tables are also included.

COTTON IN OTHER FOREIGN COUNTRIES

333. Argentina. (*Com. Belgo-Argentina*, 14/4/48. From *Cott. and Genl. Econ. Rev.*, 15/4/48.) During March beneficial rains fell in a number of districts, though the western part of the Chaco continued to suffer from lack of humidity. In the last few days of March temperatures were below normal, which hindered the ripening of the bolls which were about to burst. The presence of various pests was noted, amongst others, caterpillars and weevils which caused considerable damage in some areas. With the advent of cooler nights it is hoped that these pests will be checked.

334. Chaco Cotton Soils: Fertility. By E. F. Paulson *et al.* (*Algodon*, No. 131/32, 1946. In Spanish. From *Summ. Curr. Lit.*, xxviii, 4, 1948, p. 85.) An exhaustive study has been made of the soils of the cotton-growing regions of the Chaco (Argentina), including their physical, physico-chemical, and chemical characteristics, with a view to their better and more rational utilization. The methods used are indicated, and detailed results are presented in a large number of tables. Photographs showing the natural vegetation and cultivations in these regions, and photographs and graphs illustrating the composition of the soil profiles are also given.

335. Belgian Congo: Cotton Prospects, 1947-48. (*Bull. Comm. Cotonn. Congolaise*, April, 1948.) *Northern Zones.*—There is not enough definite information to estimate the 1947-48 production, but it is doubtful if the harvest will exceed that of 1946-47. Up to the middle of November the situation was about normal, climatic conditions having been favourable to germination and subsequent plant growth, while insect damage was not serious. Unfortunately, after mid-November excessive rains succeeding excessive dryness affected both the quantity and quality of the crop. From the information obtained, the best that can be hoped for is that the harvest for 1947-48 will equal that of the preceding season.

Southern Zones.—Cotton production reached 59,845 tons, a slight increase over that of 1946-47. The disappointing progress made in production was due to insect damage in the districts of Maniema and Ruanda-Urundi; a decrease in the number of growers and in the acreage cultivated; an incomplete system of propaganda among the natives, and inadequate directions to planters in regard to the choice of land, etc.

At a Cotton Conference held last October it was decided to expand the cultivation of the GAR variety of cotton in the Southern zones. The Triumph variety will be steadily replaced in all districts except that of Gandajika, a decision in regard to which has yet to be taken. This vast programme for the introduction of GAR is planned to be completed by the 1950 season.

336. Rapport Pour Les Exercices 1944 et 1945. (*Publ. Inst. Nat. Etud. Agron. Congo Belge*, 1947. From *Rev. App. Mycol*, xxvii, 3, 1948, p. 122.) In the section of this report dealing with plant disease work in the Belgian Congo during the period under review, R. L. Steyaert and J. Moureau state that in further studies at Bambesa on resistance to *Fusarium vasinfectum*, using 40 selected lines and varieties of cotton infected artificially with the pathogen, it was found that Arkansas 17 and B.P.52 were highly resistant, and Stoneville 5A, Stoneville 04, Gar. 32 and 33, and

Lubarika 34 showed good resistance. Two hundred and thirty-five plants were selected for outstanding resistance. During a systematic survey of the cotton-growing areas of Bambesa and Dingila in 1945, visits were made to 10 per cent. of the fields and 100 foci of infection by *F. vasinfectum* were discovered. A less systematic inspection at Titule revealed 25 foci, and another near Yandongi (Ubangi) showed about 30 fields to be affected, half of them very seriously. The disease was also observed at Bozene (Ubangi).

337. BRAZIL: COTTON PROSPECTS, 1948. (*Cott. and Genl. Econ. Rev.*, 14/5/48.) Recent rains have improved prospects for the start of the new Northern crop. The high prices currently ruling have stimulated increased interest in cotton, and the acreage planted is estimated in local trade quarters at between 7 per cent. and 12 per cent. increase on the 1947 area. Given a normal growing season, it is expected that the 1948 crop with be around 105-110,000 tons as compared with last season's disappointing yield of around 91,000 tons. A firm tone continues to prevail in local markets.

338. CAMPINAS COTTON, DEVELOPMENT. By I. Ramos. (*Indus. Textil.*, **16**, 1947, p. 38. From *Summ. Curr. Lit.*, xxviii, **5**, 1948, p. 115.) The author describes the history from small-scale trials to large-scale cultivation, of the "I. A. Campinas 817," a new variety bred from the American Stoneville 2B, first imported into Brazil in 1936. It is claimed to have a staple length and ginning out-turn at least equal to any other Brazilian variety, and to give a far higher percentage of first pickings than any of the others. Production figures and physical characteristics of this and similar varieties are shown.

339. BURMA: COTTON INDUSTRY PROGRESS. (*Cott. and Genl. Econ. Rev.*, 12/3/48.) During the Japanese occupation little or no cotton was grown, but the Agricultural Department has since stimulated production, and the Upper Burma crop, which for 1946 was some 8,000-10,000 bales, was 20,000 bales in 1947, and would have been 30,000 bales but for cyclonic weather at the time of the harvest. The Lower Burma crop, which was only 800 bales in 1946, is expected to yield somewhere near 3,000 bales this season. . . . Although the crop has increased, progress would have been greater but for the lack of seed, shortage of plough cattle and lack of security in the districts. The common strains of cotton in Burma are of poor quality and will not normally spin to better than 10½s. The Agricultural Department has, however, been experimenting with improved strains for a number of years before the war, and they prudently sent to India in 1942 samples of two of their best strains, from which derivatives are now being propagated and a small crop was grown during the past season.

340. FRENCH TEXTILE INDUSTRY: MODERNIZATION, RE-EQUIPMENT AND EXPANSION. By Commission du Textile. (*Teintex*, **12**, 1947, p. 113. From *J. Text. Inst.*, xxxix, **2**, 1948, A116. In French.) The Commission du Textile (including eight sub-commissions) has drawn up a 1947-1950 production and modernization plan for the French textile industry. The article briefly states the main objectives of the plan, and then gives detailed statistics of clothes requirements in this period; suggested man-power, capital expenditure, production, import and export figures are given and compared with those of the immediate pre-war and post-war periods. An account is finally given of the work done by and the structure of the "Commissions de modernisation des textiles."

341. GREEK COTTON GROWING AND MANUFACTURING INDUSTRY: DEVELOPMENT. By W. Wegener. (*Zellwolle, Kunstseide, Seide*, **47**, 1942, p. 769. In German. From *Summ. Curr. Lit.*, xxviii, **4**, 1948, p. 85.) The development of cotton cultivation in Greece is briefly reviewed and the cotton industry in the country is described. Figures are presented showing the area under cotton, total cotton production, and yield per hectare for the years 1923 to 1941. Cultivation practices, cotton pests, cotton varieties, and quality are briefly considered, and a brief account is given of the work of the Cotton Institute at Salonika. Figures relating to the Greek cotton textile industry, including number of spindles, number of automatic looms, pro-

duction and import of ginned cotton, cotton yarn and fabric production, and yarn exports over a number of years, are also presented.

342. PERSIA: COTTON PROSPECTS, 1948. (*Cott. and Genl. Econ. Rev.*, 7/5/48.) The acreage under cotton is expected to be increased considerably this year as a result of current favourable prices and the lifting of the ban on cotton planting in certain areas in the southern part of the country.

343. TURKEY: COTTON INDUSTRY, 1947-48. (*Cott. and Genl. Econ. Rev.*, 7/5/48.) Hot winds and consequent dryness considerably reduced cotton yields in Tchoukourova during the past season, and latest returns point to a crop of 110,000 bales from an acreage of 189,325 hectares. In the Egee districts, where cotton is generally grown under irrigation, the crop turned out well, and it is estimated that 70,000 bales have been harvested from 36,630 hectares. The total 1947-48 Turkish cotton crop is estimated at 221,000 bales. To assist and encourage an extension of cotton growing, the Government has decided to increase this year the prices guaranteed to farmers by 30 piastres per kilo of cotton lint for all qualities. Thus the price of first quality Acala becomes 165 piastres.

SOILS, SOIL EROSION AND FERTILIZERS

344. RESULTS OF TESTS ON VEGETATED WATERWAYS, AND METHOD OF FIELD APPLICATION. By M. B. Cox and V. J. Palmer. (*Misc. Pubn. No. MP*-12. Oklahoma Agr. Exp. Sta., 1948.) Results are presented of four years of research on the usefulness of the following grasses in protecting waterways from erosion:— alfalfa, Bermuda grass, blue grama grass, buffalo grass, weeping lovegrass, and a mixture of tall and short grasses native to Oklahoma. The best results were obtained with Bermuda grass, while alfalfa, weeping lovegrass, and the native grass mixture were the least effective in preventing bed erosion.

345. BALANCED MANURING. By W. G. Ogg. (*Rhod. Agr. J.*, xliv, **6**, 1947, p. 625.) A discussion of the subject under the headings of: The Opposition to the Use of Fertilizers; The Alleged Harmful Effects of Fertilizers—(*a*) Effects on the Soil; (*b*) Effects on the Plant; (*c*) Effects on Animals. Balanced Manuring. It is generally agreed that organic manures are very beneficial and should be conserved and used as extensively as possible. Every farmer knows that they improve the physical condition of the soil, promoting good tilth, water-holding power, and aeration. At the same time, they provide nutrients both for plants and for the living organisms in the soil. Because these manures usually contain all or most of the elements necessary for plant growth, and are not too rapid in their action, their use is relatively safe even in the hands of the inexperienced. But although they contain a wide range of nutrients, these are often somewhat ill-balanced, and if the most effective use is to be made of them, they must be supplemented by fertilizers.

346. TRACE CONSTITUENTS IN SOILS AND PLANTS: THEIR SIGNIFICANCE AND SPECTROGRAPHIC DETERMINATION. By R. L. Mitchell. (*Research*, 1, **4**, 1948, p. 159.) In addition to the so-called major nutrients, potassium, phosphorus, nitrogen, sulphur, calcium, magnesium and iron, which, together with carbon, hydrogen and oxygen, are recognized as essential for the healthy growth of plants, analysis of plant ash reveals the presence of other constituents present in trace quantities, some of which are essential to the plant, whilst others, according to our present knowledge, serve no useful purpose in the plant. At the Macaulay Institute spectrographic methods are being applied to the quantitative determination of the trace constituents present in plants, and in the soils on which they are grown. The content of the plant is of significance not only to the plant but to the animal consuming it, and in collaboration with the Animal Diseases Research Association, various animal disorders are being investigated which might be attributable to abnormal trace element contents of the diet.

STATISTICAL TREATMENT, CULTIVATION, GINNING, ETC.

347. Mathematical Methods of Statistics. By H. Cramer. (*No. 9 Princeton Mathematical Series.* Princeton University Press, 1946. Price: $6.00. Reviewed *Pl. Bre. Abs.*, xviii, 1, 1948, p. 175.) The book is divided into three parts. The first, "Mathematical Introduction," has chapters on set theory, the theory of Lebesgue measure and integration, and on various additional topics which are relevant to the subsequent treatment, such as Fourier integrals, matrices, beta and gamma functions, etc. The second part, entitled "Random Variables and Probability Distributions," provides the connecting link between probability theory and statistics. It deals with statistical regularity, independence, the central limit theorem, correlation and regression, and other subjects. A fair amount of space is devoted to the normal distribution because of its practical importance, and Cramer discusses the theoretical and experimental justification of the emphasis laid on this distribution. Finally, the third part, "Statistical Inference," is concerned with sampling distributions, the problem of estimation, tests of significance and the general theory of testing statistical hypotheses. Sheppard's corrections, goodness of fit, the method of maximum likelihood, confidence regions, etc., all receive their share of rigorous exposition. The two final chapters are devoted to the analysis of variance and regression problems respectively. The book contains numerous interesting examples, historical notes and references to the literature. Tables of the normal distribution, percentage points of the χ^2 and t distribution, and a bibliography provide useful appendices. . . . While this book is clearly not intended for the experimenter who merely requires to be acquainted with a number of practical statistical techniques, it will be welcomed by the mathematical statistician who aims at a deeper understanding of the theoretical foundations of his subject. Although Professor Cramer does not cover so wide a range of modern statistical methods as Wilks does, for instance, in his "Mathematical Statistics," his treatment throughout is clear and lucid, and this excellent book will undoubtedly become a standard work of reference.

348. Use of Small-Size Plots in Yield Surveys. By P. V. Sukhatme. (*Nature*, **160**, 1947, p. 542. From *Pl. Br. Abs.*, xviii, 1, 1948, p. 2.) Rectangular sample plots of $\frac{1}{80}$ acre are recommended for crop yield surveys. The over-estimation of yield which has resulted from the use of smaller plots is attributed to the inclusion of border plants within the plots; the addition of a single plant may easily bias estimation when the plots are small.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL

349. Cotton Insecticides: Testing. By E. E. Ivy and K. P. Ewing. (*J. Econ. Ent.*, **40**, 1947, p. 568. From *Summ. Curr. Lit.*, xxviii, 5, 1948, p. 116.) Results are reported of laboratory and cage tests with chlordane, sabadilla, *Ryania*, hexaethyl tetra-phosphate, azobenzene, and piperonyl compounds. Ca arsenate, DDT, and nicotine were included in these experiments. All materials were applied as dusts. The test insects were bollworms, boll weevil, cotton leafworm, cotton aphids, and cotton flea hopper.

350. Cotton Insects. By W. C. Nettles and L. M. Sparks. (*Circ.* 312. Clemson Agr. Coll. S. Carolina, 1948.) A brief illustrated account of the life history and injury caused to cotton by the boll weevil, cotton leafworm, cotton aphid, cotton flea hopper, American bollworm, and red spider.

351. Cotton Insect Pests: Control. By J. C. Gaines. (*J. Econ. Ent.*, **40**, 1947, p. 434. From *Summ. Curr. Lit.*, xxviii, 4, 1948, p. 86.) Experiments with a number of insecticides showed that basic copper arsenate was effective against bollworm and gave the greatest increase in cotton yields. Mixtures containing Cu applied as dusts, increased yields by 16 per cent. on the average. The action of Cu is believed to be due in part to its stimulating effect on the plants, and in part,

possibly, to its fungicidal action. Lead arsenate proved to be almost as effective as calcium arsenate for controlling heavy infestation of boll weevil; it was more effective than calcium arsenate against bollworms. Gammexane dust controlled boll weevil and prevented aphid increase, but did not control bollworms.

852. COTTON INSECT PESTS: CONTROL BY INSECTICIDES. By J. C. Gaines and H. A. Dean. (*J. Econ. Ent.*, **40**, 1947, p. 365. From *Summ. Curr. Lit.*, xxviii, **4**, 1948, p. 86.) Experiments showed that a minimum dosage of 8 oz. of Gammexane per acre, applied as a dust, was necessary for adequate control of severe boll weevil infestations. All concentrations of Gammexane used prevented increase of *Aphis gossypii*, but resulted in increased bollworm injury. DDT at 5 per cent. in dusts controlled bollworms, but not boll weevils, and it resulted in aphid increases. When sulphur was not used, red spiders were noted on plots treated with DDT and Gammexane. A mixture of these was effective against weevils, bollworms, and aphids, but did not increase cotton yields over calcium arsenate alone. Gammexane caused discomfort to those applying it, and also some foliage injury. Calcium arsenate and Gammexane did not react the same against the bollworm on different cotton varieties; this difference affected yields.

853. COMPARATIVE EFFECTIVENESS OF VARIOUS INSECTICIDES AND METHODS FOR CONTROLLING COTTON INSECTS. By C. F. Stiles and F. A. Fenton. (*Circ. C*-126. Oklahoma Exp. Sta., 1948.) Benzene hexachloride has been tested against boll weevils in Oklahoma for two years. In 1946 a 5 per cent. gamma benzene hexachloride dust (Gammexane) at 10 lb. per acre gave approximately the same control as calcium arsenate at 6 lb. per acre. In 1947 a 5 per cent. gamma BHC used at the same rate per acre gave outstanding control against boll weevils. No plant injury by this insecticide has been noticed in Oklahoma, but in certain south-eastern states slight leaf burning has been observed. BHC is not effective against the bollworm, and in some cases seems to favour multiplication of this pest. Peanuts or potatoes should not be planted in fields where cotton was dusted with BHC the previous year. Root crops growing in soil contaminated with BHC are tainted. A mixture containing 3 per cent. gamma BHC, 5 per cent. DDT, and 40 per cent. sulphur has been especially effective as a cotton insecticide. The BHC controls all pests except the bollworm and red spider; these are killed by the DDT and sulphur. Red spiders may develop in cotton treated with DDT or BHC. Applications should average 10 lb. per acre. Calcium arsenate used at the rate of 6-8 lb. per acre is very effective against the boll weevil and leafworm. At this rate, however, it gives poor control of bollworms and often causes a destructive increase in cotton aphids. Chlorinated camphene (*Toxaphene* and other trade names) was tested in 1947 to 10 and 20 per cent. strengths at 10 lb. per acre. There was no significant difference between the two so far as boll weevil control was concerned. It does not seem to be as effective as BHC under Oklahoma conditions. Tests in other states show that 20 per cent. at 10 lb. per acre gives best results. This chemical controls boll weevils, bollworms, cotton flea hoppers, leafworms, and several species of plant bugs. A 10 per cent. chlordane dust was tested in 1946 in Oklahoma at 10 lb. per acre and gave approximately the same control of boll weevils as calcium arsenate. Leaf injury was observed, but was not serious. In 1947 an improved mixture as regards dusting properties was tested in the state at 5 per cent. strength at 10 lb. per acre. Poor control of the boll weevil was obtained. Three applications caused leaf injury. Other states report that a 10 per cent. mixture gave boll weevil control equal to calcium arsenate, with no plant injury. A mixture containing 3 per cent. chlordane and 3 per cent. DDT has been tested in other states and found to be inferior to calcium arsenate for controlling boll weevils. In some tests this mixture favoured cotton aphids and red spiders. Parathion (Thiophos or 3422) is a relatively new insecticide. It is highly poisonous and has a pungent, disagreeable odour. Tests in Oklahoma have been made with 1 and 2 per cent. dusts. Results here and in other states indicate that further tests should be made. Concentrations above 2 per cent. would be very obnoxious and probably dangerous to the operator. DDT

controls the bollworm and tarnished plant-bug but is ineffective against the boll weevil, leafworm, and cotton aphid. It gives good control of the bollworm at 10 per cent. strength at 10 to 15 lb. per acre. A 2 per cent. nicotine in alternate applications of calcium arsenate or a 1 per cent. nicotine in all applications will prevent a cotton aphid infestation if properly applied. Present trends show that sulphur has an important place as a diluent for insecticides when a non-alkaline filler is needed, such as when mixing BHC and DDT. Its cost is low, and it is generally available. It is also toxic to red spider, so it can be used with some of the newer materials which favour red spider build-up. It is inflammable and a sulphur mixture should be kept away from tractor exhausts, sparks, or flames. Bug-catching machines are not recommended. No mechanical device has yet been found by federal or state investigators to be equal to chemicals for controlling cotton insects. Samples of insects collected by one such machine in Oklahoma showed hundreds of beneficial insects caught, and a few boll weevils. Dusting is the only method which gives good control of all cotton insects with the materials and equipment now generally available. However, leafworms can be controlled by spraying.

354. COTTON INSECT PESTS: CONTROL BY GAMMEXANE. By K. P. Ewing *et al.* (*J. Econ. Ent.*, **40**, 1947, p. 374. From *Summ. Curr. Lit.*, xxviii, **4**, 1948, p. 86.) Large and small field plot experiments were made with Gammexane, DDT, Ca arsenate, nicotine sulphate, and cryolite, alone or in mixtures, against boll weevil, cotton aphid, cotton leafworm, and bollworm. Gammexane controlled all these insects except the bollworm, but a mixture with DDT controlled the bollworm as well, and more effectively than either of the components alone. The mixtures also proved superior to Ca arsenate, and Ca arsenate + 2 per cent. nicotine. Gammexane was superior to 3 per cent. nicotine in lime as an aphicide. In cage and field tests it killed boll weevils more quickly than Ca arsenate, but lost its toxicity within about two days; against cotton leafworm its residual effect was greater than that of Ca arsenate.

355. CHLORINATED CAMPHENE: APPLICATION AGAINST COTTON INSECT PESTS. By E. E. Ivy *et al.* (*J. Econ. Ent.*, **40**, 1947, p. 513. From *Summ. Curr. Lit.*, xxviii, **5**, 1948, p. 115.) A product, Toxaphene, containing 50 per cent. of chlorinated camphene and 50 per cent. of a commercial clay was tested against several species of cotton insects in cage and field experiments. Several other insects were tested in comparison. Against the bollworm a dust containing 20 per cent. Toxaphene at 16 lb. per acre was as effective as 5 per cent. DDT dust, and at 8 lb. per acre it controlled boll weevils as well as Ca arsenate or benzene hexachloride. The cotton aphid was controlled by 20 per cent. dust at 10 lb. per acre as well as by 2 per cent. nicotine dust, but benzene hexachloride was more effective. At 8 lb. per acre against cotton leafworm 10 per cent. Toxaphene dust compared favourably with Ca arsenate, and cotton flea hoppers were controlled by 1 per cent. dust at 12 lb. per acre. In field experiments, 20 per cent. Toxaphene dusts controlled comparatively heavy infestations of bollworms, weevils, aphids, and leafworms; weevil control was about as good as with Ca arsenate, and bollworm control was slightly better. A mixture of 5 per cent. DDT and benzene hexachloride was slightly better than Toxaphene for bollworm control and about equal to Toxaphene in effectiveness against weevils, aphids, and leafworms. The plots treated with Toxaphene and with the DDT-benzene hexachloride mixture gave significantly greater yields of seed cotton than those treated with Ca arsenate.

356. COTTON APHIDS: OCCURRENCE AND CONTROL. By D. Isely. (*Arkansas Sta. Bull.*, 1946, p. 462. From *Summ. Curr. Lit.*, xxviii, **5**, 1948, p. 116.) The cotton aphid causes serious losses to cotton only after dusting the plants with calcium arsenate for boll weevil control, as dusting reduces the number of insect enemies which ordinarily hold aphids in check. Under optimum conditions, cotton aphids may begin to produce young within four days after birth. The most favourable temperature for their reproduction is 20°C.; this is not only lower than that of any other important insect pests of cotton but is lower than that of the insect enemies of

aphids. Cotton plants growing on soils well supplied with nitrogen are more favourable to aphid development. The possibility of the development of an aphid outbreak after dusting increases with the number of dust applications. Outbreaks also develop more rapidly when dusting in a region is general. A cotton aphid outbreak can be controlled by dusting with calcium arsenate containing 3 per cent. nicotine. This mixture may be used to control both the cotton aphid and the boll weevil; for the cotton aphid alone, nicotine may be combined with hydrated lime. In a limited test, 0·5 per cent. rotenone combined with calcium arsenate appeared to be effective against the cotton aphid provided it was applied to the underside of the foliage and came in actual contact with the aphids. In three years' experiments, dusting sulphur was effective in killing the aphids actually coming into contact with it.

357. BOLL WEEVIL AND COTTON APHID CONTROL INSECTICIDES. By C. F. Rainwater and F. F. Bondy. (*J. Econ. Ent.*, **40**, 1947, p. 371. From *J. Text. Inst.*, xxxix, **3**, 1948, A121.) Results of experiments with various mixtures of Gammexane, Ca arsenate, basic Cu arsenate, DDT, nicotine, rotenone, and Ryania powder against boll weevil and cotton aphid are reported. All preparations were applied as dusts, Gammexane controlled *Aphis gossypii*, and was as effective as Ca arsenate against boll weevils. Mixtures of these were incompatible and mixtures of Gammexane and basic Cu arsenate were partially so. Mixtures of DDT and Gammexane were more promising than the latter alone. Ryania powder was less effective than Ca arsenate, Gammexane, or DDT. DDT in 50 per cent mixtures was a promising insecticide for many cotton insects.

358. SOUTH CAROLINA: COTTON PRODUCTION AND BOLL WEEVIL CONTROL, 1948. By H. G. Boylston *et al.* See Abstract 326.

359. STUDIES ON EARIAS SPECIES (THE SPOTTED BOLLWORMS OF COTTON) IN THE PUNJAB: III. THE BIOLOGY OF THE COMMON PARASITES OF *E. fabia* STOLL., *E. insulana* BOISD. AND *E. cupreoviridis* WALKER. By M. Haroon Khan and P. M. Verma. (*Ind. J. Ent.*, **7**, 1-2, pp. 41-63, 1946. From *Rev. App. Ent.*, xxxvi. Ser. A., **4**, 1948, p. 120.) The results are given of studies in 1934-37 on the bionomics of five parasites of *Earias fabia*, Stoll, *E. insulana* Boisd., and *E. cupreoviridis* Wlk., on cotton in the Punjab. Each of them attacks all three species of *Earias*, and the two ectoparasites of the larvæ, *Elasmus johnstoni*, Ferrière, and *Bracon lefroyi*, D. and G., also attack *Platyedra gossypiella*, Saund. The female of *Elasmus johnstoni* deposits one or more eggs on or near a host larva enclosed in a flower bud of cotton; only 1 or 2 eggs or larvæ were found on individual larvæ of *P. gossypiella* either in the field or in the laboratory, but there were usually more than one on larvæ of *Earias*, with a maximum of 5 in the laboratory and 21 in the field. Individual females laid about 18 eggs during September-October or about 13 in November. When the mean temperature fell below 75° F. the maximum number of eggs laid by one female was 31. Unmated females produced male offspring. Males and females provided with sugar solution and allowed to reproduce survived in the laboratory for 5-16 and 7-46 days, respectively. Development required 10 days during the hotter months and 28 days or more in the cooler ones, and an experiment showed that it could be completed on larvæ that had spun their cocoons. *Bracon lefroyi* normally attacks larvæ within the flower buds or bolls; the number of eggs on individual hosts varied considerably, but was usually 1-4. In June-September females laid most of their eggs within 6 days of emergence, and all in 15-18 days, but oviposition became irregular and more protracted as the temperature fell, though it still occurred in December at a mean temperature of about 60° F. The maximum number of eggs laid by one female was 143; the average per female was highest (over 45) at mean temperatures of 81-87° F. The survival period of the adults varied from 2 to 83 days, and was shortest at high temperatures. Development was completed in 8 days during August-September and 18 in November. Females bred from *Earias* spp. oviposited more freely on *Earias* than on *Platyedra*, but those bred from *Platyedra* showed no marked preference. The largest numbers of immature parasites found on single larvæ of *Earias* and *Platyedra* in the field were 24 and 8,

respectively. Females were less numerous than males among parasites reared in the laboratory, but the proportion was increased when the parent females were allowed to mate with several males and when they were exposed to direct sunlight for an hour each day. The observations on *Rogas testaceus*, Spin., an endoparasite of the larvæ of *Earias*, in general confirmed those of Ahmad. The adults mated soon after emergence and the females began to sting host larvæ on the same day. Individual females laid only 1 egg in each host, but several sometimes oviposited in the same larva. The paralysed larvæ became active and fed normally after 8-12 minutes, but stopped feeding again after a period of days depending on the temperature, and died shortly afterwards. The largest number of larvæ parasitized by one female was 18; the survival period of females provided with food and allowed to mate and oviposit varied from 5 to 73 days and was shortest at high temperatures. In general, males were more numerous than females. *Brachymeria tachardiæ*, Cam., is an endoparasite of the pupæ of *Earias*. The females stung individual pupæ repeatedly, but deposited only 1 egg in each; the largest number parasitized by one female was 40. Oviposition ceased at a mean temperature of about 60° F. The duration of the life-cycle ranged from about 11 days in June to 96 days in the field in winter, when the immature stages survived minimum temperatures of 32° F. or less. The parasite was unable to develop at a temperature of 98·5° F. The sex ratio was about equal in the field, but males were more numerous among parasites reared in the laboratory. The females, which lived longer than the males, survived for 6-19 days during July-September and for up to 132 days during November-March. *Goryphus nursei*, Cam., is an ectoparasite of the pupæ of *Earias* and deposits its eggs on the pupæ within their cocoons. Females laid 15-51 eggs, depositing 1-7 on individual pupæ. The eggs were not evenly distributed among the available hosts, some receiving none when others received several. Oviposition continued throughout the life of the female; most eggs were deposited 4-6 days after emergence in April and during the first 3 days in August-October. When paired parasites were provided daily with fresh host pupæ, the largest number of progeny obtained from one pair was 14; neither moth nor parasite emerged from most of the pupæ, and it is thought that several eggs were laid on each and that the food supply was insufficient for the resulting larvæ. The survival period of females varied from 5 days in June to 102 in winter; that of males was rather shorter. The duration of the life-cycle ranged from 10 days in summer to 86 in winter. The sex ratio appeared to be approximately equal. It is probable that all five parasites overwinter in both adult and immature stages.

360. Tests for Eelworm Resistance in Various Cottons. By B. L. Mitchell. (*11th Ann. Rpt. Cott. Res. and Indus. Bd. S. Rhodesia*, 1946-47. Received 1948.) Tests were carried out during the 1945-46 season at the Tobacco Research Station, Trelawney, to determine the resistance of the following strains of cotton to eelworm galling: 3 strains of 9L34 family group; 3 strains of 7L5 family group; 2 strains of 7C family group, being crosses between U4's and Cambodia in 1937. The seed of the various strains was supplied by Major Cameron, of the Cotton Research and Industry Board.

The eight cottons were all lightly infested with eelworm during the season in a soil known to be very heavily infested. There was no significant difference between any of the strains, the mean infestation being 17·8 per cent. The galls formed on the cotton roots were not of the large permanent type that occurs in tobacco. The gall is not allowed to grow, but the rootlet dies and is shed by the plant at a comparatively early stage. It is possible that this intolerance of the cotton rootlets to eelworm galling may be the key to the reason why the infestation of tobacco following cotton is so much reduced. The rootlets may act as a trap crop, becoming infested with eelworm, but being shed from the plant before the nematode has time to reproduce. If this be the case, the eelworm population would be absorbed and destroyed.

361. Cotton Leafworm: Control by DDT and Calcium Arsenate. By J. C.

Gaines and H. A. Dean. (*J. Econ. Ent.*, **40**, 1947, p. 454. From *Summ. Curr. Lit.*, xxviii, **4**, 1948, p. 87.) In individual feeding tests the LD50 values of calcium arsenate and 5 per cent. DDT in pyrophyllite for third instar larvæ of *Alabama argillacea* were 0·255 mg. and 1·357 mg. per g. body weight, respectively. The dosage mortality curves of the two insecticides are given in a graph.

362. STUDIES ON *Schistocerca gregaria* FORSK: XIII. SEXUAL LIFE. By M. Afzal Husain and C. B. Mathur. (*Ind. J. Ent.*, **7**, 1-2, pp. 89-101. 1946. From *Rev. App. Ent.*, xxxvi, Ser. A., **4**, 1948, p. 122.) The process of mating in *Schistocerca gregaria*, Forsk., and the behaviour of the locusts during it are described from observations made in the Punjab. The locusts are less easily disturbed when mating than at other times, and it is suggested that swarms that have settled for this purpose could be destroyed by beating with bushes or wire gauze beaters. Experiments in which natural phenomena were simulated showed that mating is not interrupted by rain, noise or moderate wind, and is interrupted by flooding only when the water is deep enough to reach the male. It is concluded that swarms are disturbed by the movements of men beating drums and tins and not by the noise made by them. Both the duration and frequency of mating varied. The pre-oviposition period of females mated with young males was shorter than that of females of the same age mated with older males. Four of 35 unmated females each deposited an egg pod after a pre-oviposition period of a month and the two that hatched each gave rise to males and females in approximately equal numbers; these were reared to the adult stage, but attempts to produce a second parthenogenetic generation were unsuccessful.

363. SHORT NOTES AND EXHIBITS. (*Ind. J. Ent.*, **7**, 1-2, pp. 237-242. 1946. From *Rev. App. Ent.*, xxxvi, Ser. A., **4**, 1948, p. 122.) K. B. Lal states that extensive oviposition by *Schistocerca gregaria*, Forsk., occurred in the third week of July, 1942, in open land near Orai in the United Provinces. Examination on August 2, when the eggs were being dug up as a control measure, and a few had hatched, showed that 15-20 per cent. of the egg-pods were being attacked by earwigs; these destroyed only some of the eggs in the pods, and were not numerous enough to cause any appreciable reduction in the numbers of the locusts.

364. LA LUTTE CONTRE LES TERMITES. By C. Noriot and H. Alliot. (Pubn. de l'Office de la Recherche Scientifique Coloniale, Masson et Cie, Paris, 1947. Price 220 francs. From *Nature*, 10/4/48, p. 544.) This publication provides the best short modern account of termites and their control. It is, furthermore, extremely well illustrated. The first part deals with the general biology of termites and the outlines of their classification. The second part is devoted to the application of various methods for destroying those insects, and part 3 describes in some detail, and with many structural diagrams, the best method for protecting woodwork against termite attack, and the special features needed in building construction in guarding against their depredations. Each section is accompanied by a short but adequate list of references to the relevant literature that may be consulted.

365. DISEASES OF FIELD CROPS. By J. G. Dickson. (McGraw-Hill Book Co. Inc., London and New York, 1947. Price 22s. 6d. Reviewed *Pl. Bre. Abs.*, xviii, **1**, 1948, p. 182.) The present volume, covering crop diseases in all parts of the world, contains four sections, two appendices, and an efficient index. Section one includes a general introduction and a chapter on the physiological anatomy of plant groups in relation to disease. The second section deals with diseases of cereals and grasses (barley, maize, millet, oat, rice, rye, sorghums, Sudan grass, Johnson grass, sugar cane, wheat, and forage grass). Legume diseases (lucerne, sweet clover, clover, and soya bean) are described in the third section, and the final one deals with cotton, flax, and tobacco diseases. One of the appendices usefully lists the bacteria and fungi parasitic on field crops. For each plant mentioned there are introductory paragraphs concerning the crop, followed by the descriptions of the diseases arranged according to the primary causal agent—namely, non-parasitic causes, viruses, bacteria, fungi. . . . Each chapter not only marshals a great many facts, presented in eminently readable form, but abounds in references, and for this latter reason alone

the book is a mine of information. Other features are the numerous excellent illustrations and the inclusion of the diagnostic characters of the causal fungi.

366. OCCURRENCE OF COTTON FIBRE CONTAMINATED BY *Aerobacter cloacæ*. By F. E. Clark *et al.* (Bureau of Pl. Indus, Soils, and Agr. Eng., T.935. Price 10 cents.) Presents the results of bacteriological surveys of ginned fibre and of field and laboratory observations on the growth and development of *Aerobacter cloacæ*.

367. COTTON ROOT ROT: RECOVERY OF COTTON. See Abstract 391.

368. IMPROVING WILT RESISTANCE AND YIELD OF COTTON BY ROGUING AND SELECTION. By J. R. Cotton. See Abstract 392.

GENERAL BOTANY, BREEDING, ETC.

369. PROGRESS REPORTS FROM EXPERIMENT STATIONS, 1946-47. (Published by the Empire Cotton Growing Corporation, 1948. Price 3s. post free.) Progress reports are included summarizing the work carried out during the 1946-47 season at the experiment stations in Queensland, South Africa, Southern Rhodesia, Anglo-Egyptian Sudan, Uganda, Tanganyika Territory, Nyasaland, Nigeria, and the West Indies. The reports on the work in Queensland, Nigeria, Southern Rhodesia, Uganda, and the Leeward and Windward Islands of the West Indies, are included by courtesy of their respective Governments. Useful work was continued at the stations in connection with cotton genetics and breeding, varietal trials, fertilizer experiments, rotation of crops, and in research on cotton pests and diseases. Programmes of experiments for the 1947-48 season are also included. These reports should prove of much interest and value to all who are concerned in any way with the cultivation of cotton and similar crops.

370. CYTOGENETIC INVESTIGATIONS IN SOME *Arboreum-anomalum* CROSSES. By M. Afzal *et al.* (*Ind. J. Genet. Pl. Brd.*, 5, 1945, p. 82. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 106.) Meiosis was studied in the following three F_1 hybrids between *Gossypium arboreum* var. *neglectum* f. *bengalensis* and *G. anomalum*: Jubilee × *G. anomalum*; Arboreum Red × *G. anomalum*; and Karunganni 1 × *G. anomalum*. The pollen mother cells of the different hybrids and also of each hybrid showed considerable variation in the extent of chromosome conjugation. Anomalous behaviour of the univalents and the formation of single and double chromatin bridges during anaphases I and II resulted in the formation of micronuclei and microcytes with varying chromosome numbers, and the hybrids were thus highly sterile. Most of the seeds set were non-viable. About 1·5 per cent. of the seeds germinated; the plants derived from these had a chromosome number of $2n=26$. Back-crossing experiments were carried out on the hybrid Jubilee × *G. anomalum*. By back-crossing this hybrid twice to Jubilee and selecting for high boll number and seed setting in subsequent generations, fully fertile strains have been secured which possess completely white lint, and which are superior to Jubilee in yield of seed cotton, ginning pecentage, staple length, and fineness of lint. The value of *G. anomalum* in improving staple length and other characters in *G. arboreum* and *G. herbaceum* cottons is discussed with reference to the colchicine technique of chromosome doubling to overcome the sterility of the cross *G. armoreum* × *G. anomalum*. In view of the results obtained by the authors, it is considered that the technique of recurrent back-crossing is more satisfactory.

371. NOTES DE BIOLOGIE VÉGÉTALE: II. CYTOGÉNÉTIQUE. By J. Lefèvre. (*Ann. Inst. Nat. Agron.*, 31, 1939, p. 29. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 42.) An account is given of the general characteristics of autopolyploids and allopolyploids and their origin under natural conditions. Various methods of inducing polyploidy artificially are discussed, and the effects of colchicine on meiosis are described. Mutations with visible effects have been brought about by very diverse methods of treatment, and various effects have been produced in one and the same plant. The author points out that the use of colchicine does not yet constitute an easy and certain method for regular production of tetraploids as is commonly thought. The

production by means of other substances of effects similar to those obtained by treatment with colchicine is discussed. The author then deals with the possible application of these new methods to cultivated plants, and observes that if it were possible to reduce the number of chromosome sets so as to produce a haploid and then to convert this into a diploid by doubling the chromosomes, a completely homozygous plant would be produced. Comparisons are made between the action of phenylurethane and colchicine, and between that of anethol and substances of the colchicine group.

872. COTTON GENETICS. By S. G. Stephens and B. J. Cassidy. (*Year Book of the Carnegie Institution of Washington*, 1945-46, p. 186. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 27.) The development of the seed of the hybrid *Gossypium arboreum* × *G. Davidsonii* was studied. The early death of the embryo, which has always been observed in this interspecific hybrid, was found to be due to the failure of the endosperm. Attempts to culture immature embryos have so far proved unsuccessful. Partially fertile allotetraploids have been synthesized by colchicine treatment of hybrids between *G. arboreum* and *G. herbaceum* on the one hand, and the two wild Old World species *G. anomalum* and *G. Stocksii* on the other. These allotetraploids are to be intercrossed with a view to comparing the genetics of the genomes of *G. anomalum* and *G. Stocksii*. Chemical studies were made of the pseudo-allelic series conditioning anthocyanin pigmentation in the Asiatic cottons, in order to investigate the origin of two neighbouring loci. The results indicate that adjacent genes control closely similar chemical reactions, but act on distinct though chemically similar substrates, supporting the view that the two loci originated by a process of duplication, which has been accompanied or succeeded by the development of specificity in substrate requirement. The probable cause of pseudo-allelism in the Crinkle (cr^D) and Contorta (cr^C) series, affecting plant growth in the New World amphidiploid cultivated cottons and apparently associated with the synthesis of indole, is also being investigated.

873. THE SOVIET GENETICS CONTROVERSY. By J. L. Fyfe. (*Modern Quart.*, 2, 1947, p. 347. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 30.) The theories of Lysenko are criticized on various scores, particularly for their ignoring almost the whole body of recent research in Mendelian genetics. It is emphasized, however, that Lysenko's experiments cannot be summarily dismissed, and should be repeated under carefully controlled conditions. Recent developments in Mendelian genetics are just as inconsistent with the elementary genetics of the textbooks as some of Lysenko's theories.

874. A FOOTNOTE ON THE SOVIET GENETICS CONTROVERSY. By J. Lewis. (*Modern Quart.*, 2, 1947, p. 352. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 31.) Four questions are discussed: (1) Whether Lysenko is right or wrong; (2) has Lysenko received undue support from the Soviet authorities; (3) has scientific objectivity in Russia been prejudiced by ideological considerations, and (4) have Russian geneticists been persecuted. The author replies as follows: (1) Severe criticism of Lysenko's work is general among British and a considerable number of Russian geneticists; (2) the Soviet authorities have favoured Lysenko on account of his many undoubted contributions to Soviet agronomy. They have also supported the plant breeding work of a number of Lysenko's opponents; (3) dialectical materialism represents no more than scientific induction in its widest and most comprehensive form. Recent genetical work supports the dialectical conception of the necessary interaction between genes and their environment; (4) research along Mendelian lines has never been stopped in the U.S.S.R.

875. THE RETREAT FROM SCIENCE IN SOVIET RUSSIA. By C. D. Darlington. (*19th Century*, 142, 1947, p. 157. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 30.) A review is presented of the history of genetics in the Soviet Union from the October revolution to the present day. The account given follows in the main the monograph by Hudson and Richens, but additional information is given of the careers of many Russian scientists including Vavilov, Levitzky, Karpechenko, and others.

876. GENETICS AND SCIENCE IN THE U.S.S.R. (*Brit. Med. J.*, No. 4528, 1947,

p. 616. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 30.) An account is given of Lysenko's genetical system and of the background against which it has emerged. This follows in the main the communication of Hudson and Richens, and a recent article by Darlington. Reference is also made to the dissatisfaction expressed by recent writers in the Soviet Union to the genetical views of Zebrak.

377. Preservation of Genic Wealth of Cotton. By G. K. Govande. (*Ind. Cott. Grwg. Rev.*, II, 1, 1948, p. 35.) The writer points out that modern selection practices and restricted production have resulted in a progressive decrease in the original populations of cotton with their characteristic diversities. It is stressed that natural populations of the original cottons, untampered with by man, should be preserved for the possible requirements of future generations. The suggestion is made that the Governments concerned be asked to formulate some scheme for the maintenance of natural populations of each species in their respective cotton tracts. A tentative suggestion is also made with special reference to the *herbaceum* species of cotton.

378. Chemical Composition of Plants as an Index of Their Nutritional Status. By D. W. Goodall and F. G. Gregory. (*Tech. Commun. Imp. Bur. Hort. Plantat. Crops*, 1947, No. 17, pp. 167. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 52.) Varietal differences in chemical composition, fertilizer responses and deficiency symptoms are briefly discussed with reference to methods of plant analysis and deficiency diagnosis. Numerous references are made to papers on varietal differences.

379. The Nucleus in Relation to Heredity and Sex. By E. C. Jeffrey. (*Science*, 106, 1947, p. 305. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 41.) The general function of the nucleus in the cell, and the limitations imposed by cytological technique on the study of the nucleus are discussed. Present-day knowledge of the minute structure of the chromosomes and corresponding details of their behaviour are reviewed, and it is stated that X and Y chromosomes in insects cannot be in any sense regarded as sex determinants.

380. Tracing American Cultivated Cottons. (*59th Ann. Rpt. Texas Agr. Exp. Sta.*, 1946. Received 1948.) The known species of cotton fall into two main groups on the basis of chromosome number, one group having 13 pairs of chromosomes, the other, 26 pairs. The American cultivated varieties, including the Upland types, have 26 pairs and are considered amphidiploids; that is, genetic evidence supports the view that they originated in early times from two diploid species, each having the base number of 13 pairs of chromosomes. At the Station many different species of cotton have been crossed in order to produce new types. The sterile hybrids which result from crossing two distantly related species are generally treated with colchicine in order to double the chromosome number and so make the plants fertile. In some instances the treatment has not been necessary, as in the case of a hybrid which was produced by crossing a wild African species (*Gossypium anomalum*) with a wild American species (*G. davidsonii*). One such hybrid plant produced a fertile boll containing viable seeds which on planting gave rise to a new fertile strain. Counts of the chromosome number showed the new type to have 26 pairs, hence to be amphidiploid. The new amphidiploid is only one of several which have been produced at the Station, and which are being used in crosses with Upland cotton. A similar hybrid, produced earlier under laboratory conditions from an American wild and a cultivated Asiatic species, has been used extensively to produce strains from which lines having additional fibre strength are being selected.

381. Introduction to Plant Ecology. By A. G. Tansley. (George Allen and Unwin Ltd., London, 1946. Price: 8s. 6d. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 180.) Part I deals with the meaning and scope of ecology; Part II deals with the structure, distribution, and development of vegetation. In Part II the methods of studying vegetation by the making of maps and charts are discussed. Part IV is an elementary treatment of habitat analysis with sections on climatic, physiographic, edaphic and biotic factors. An up-to-date theoretical treatment of soil is given, and brief instructions are included for some simple field and laboratory tests, reference

being made to others which require more elaborate methods. The suggestions in Part V as to the ways in which ecology can be taught in schools should be of use to teachers in all types of schools where there are facilities for nature study out of doors. A useful list of books and papers is appended, but unfortunately it does not include the dates of publication of some of them.

382. TECHNIQUE OF BREEDING FOR DROUGHT RESISTANCE IN CROPS. By T. Ashton. (Commonwealth Bur. of Pl. Brdg. and Genetics. School of Agriculture, Cambridge, 1948. Copies obtainable from the Commonwealth Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth, Wales. Price: 2s. 6d.) Although drought is probably the most important factor adversely affecting crop production in the semi-arid regions of the world, comparatively little specific breeding for drought resistance has been carried out, on account of the complex nature of reaction to drought. In general, physiological characters, such as water requirements and transpiration rate, and morphological and anatomical characters, have not been found to provide a reliable means of testing for drought resistance. In the case of certain physico-chemical characters, such as osmotic pressure and bound water content, however, there is less general agreement as to their value in breeding investigations. In view of the uncertain nature of morphological, physiological and physico-chemical characters as an indication of drought resistance, investigators have made increasing use of direct methods of testing by field observations, pot wilting experiments, and drought and heat chambers; and in recent years, a number of valuable experiments on testing for drought and heat resistance in specially constructed chambers have been reported. This bulletin brings together the most important published information which has a bearing upon the complex problems of breeding for drought resistance in wheat, oats, barley, rice, grass species, and various other crops. Much of the literature is from Russian sources, particularly in the case of wheat. The contents of the bulletin are arranged according to the individual crops. A bibliography of 124 references is appended.

383. THE ENDOSPERM IN SEED DEVELOPMENT. By R. A. Brink and D. C. Cooper. (*Bot. Rev.*, 13, 1947, pp. 423, 479. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 43.) The formation of the female gametophyte in angiosperms is described. The origin, hereditary make-up, development and function of the endosperm are discussed. It is shown that the endosperm of gymnosperms should not be compared with that of angiosperms. A discussion is included of seed development following interspecific hybridization. Evidence is brought together concerning the effect of abnormal endosperm development on the growth and survival of the embryo in the various families in which it has been studied. The different kinds of hereditary alteration in balance between endosperm, embryo and maternal tissue, and of developmental conditions which lead to seed abortion, are discussed. The relations between pollen tube growth, inherent potentiality of the embryo and the fertility of hybrids on the one hand and seed development on the other are considered. The literature on xenia and metaxenia and on hybrid vigour of the endosperm and endosperm mosaics in maize is reviewed. The possible connection between double fertilization and polyploidy is discussed. The various kinds of parthenogenesis and apogamy are considered with reference to endosperm development.

384. EFFECT OF SEED QUALITY ON YIELD OF COTTON. By V. G. Panse and S. A. Khargonkar. (*Ind. Cott. Grwg. Rev.*, II, 1, 1948, p. 17.) Sowing of large heavy cotton seed has been found to improve germination, plant vigour, and yield. A simple method of separating such seed has been described in the present article. Field trials with this seed for two seasons have shown an increase of 10 to 15 per cent. in yield over bulk seed in *desi* strains. The ginning percentage and seed weight of the produce from large heavy seed are not different from those of the produce from the bulk seed. The method is recommended for trial and adoption for American strains also.

385. HYGROSCOPIC EQUILIBRIUM OF COTTON SEED. By M. L. Karon. (*J. Am. Oil Chem. Soc.*, 24, 1947, p. 56. From *Text. Tech. Digest*, 4, 12, 1947, p. 467.) Cotton

seed was suspended in desiccators containing saturated solutions of various salts at 26° C. Samples were removed from time to time and the moisture determined by heating at 101° C. for 16 hours in a forced-draft oven. At the end of 36 days samples of seed were removed, separated into meats and hulls (which included linters), and replaced in the desiccators for 25 hours more. Moisture was then determined at 31 to 71 per cent. r.h., the moisture content increased linearly from 6·03 per cent. to 10·27 per cent. in cotton seed. From 71 to 93 per cent. r.h., it increased rapidly from 10·27 to 22·19 per cent. More moisture was found in the hulls than in the meats. It is concluded that when cotton seed is aerated, the r.h. of the air should be considered.

386. THE USE OF SEED FROM DIFFERENT PICKINGS OF THE COTTON CROP. By A. H. Khan and M. Afzal. (*Emp. Jour. Exp. Agr.*, xvi, 61, 1948, p. 39.) The results of experiments have shown that neither the yield nor the earliness of the cotton crop suffers in any way by the use of seed from early or late pickings, and that it will be more economical to use this seed for sowing.

387. THE ESSENTIAL AMINO ACID CONTENT OF COTTONSEED, PEANUT AND SOYBEAN PRODUCTS. By C. M. Lyman *et al.* (*Bull. No.* 692. Texas. Agr. Exp. Sta. 1947.) The content of ten different amino acids in 19 samples of cottonseed, peanut, and soybean products is given. The products include cottonseed flour, both hydraulic and solvent extracted cottonseed meals, peanut flour, peanut meal, both hydraulic and solvent extracted soybean meals, soybean protein and soybean feed. With respect to three amino acids which are of particular significance in nutrition, lysine, methionine and tryptophane, the proteins of cottonseed and soybean meals were found to be definitely superior to the protein of peanut meal. With the exception of soybean protein and soybean feed, the type of commercial processing appeared to have little or no effect on the amino acid composition of the products.

388. FERTILIZATION OF PLANTS BY A LIMITED QUANTITY OF POLLEN. By D. V. Ter-Avanesjan. (*Agrobiologija*, 3, 1946, p. 71. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 107.) Emasculated flowers of the Upland cotton C-15 and the Egyptian 35-1 were pollinated with a limited number of pollen grains, up to twenty in number, so as to rule out the possibility of selective fertilization. Control flowers were emasculated and pollinated with an unlimited number of pollen grains. The experimental flowers formed from eight to fifteen seeds per boll, the seeds being smaller than those from the controls. Experimental and control seeds were sown in the same conditions. The plants arising from the seed from the same capsule of an experimental plant varied in type; in C-15 their yield of raw cotton varied from 82 to 510 grm. for instance, whereas the control plant varied only from 180 to 220 grm.; the lint length varied from 26·4 to 35 mm. in experimental plants and 31 to 31·4 mm. in controls. In 35-1 the weight of raw cotton varied from 110·2 to 306·6 grm. in experimental plants and from 156·7 to 180 grm. in controls. The seed of these plants was sown and the F_2 from each individual plant examined. Transgressive segregation occurred, the variation being greater than in the controls; plants with values exceeding the maximum of the controls were observed in respect of number of bolls per plant, yield per plant, boll weight, lint length, lint percentage and plant height. The differences were preserved also in the F_3 generation. Similar results were obtained with other varieties though the figures are not reported.

389. EXPERIMENTAL METHODS WITH COTTON: V. A STUDY OF GINNING PERCENTAGE AND ITS DETERMINATION IN VARIETY TRIALS. By W. L. Fielding. (*J. Agr. Sci.*, 38, 2, 1948, p. 154, 158.) The results of a study of sampling for ginning percentage in cotton variety trials are given. The investigation was undertaken to determine the most satisfactory method of obtaining the necessary ginning percentage factors for conversion of yield of seed cotton to yield of lint. The material consisted of a wide range of strains derived from the jassid-resistant Upland, U.4, planted out in trials of randomized block design, in different seasons. Taking of samples as the bulk produce was brought to the scale for weighing was found to be the most satisfactory of three methods of collection of samples in the field which were tried out.

A sample size of 200 g. was found to be ample. No objection was found to bulking small handfuls of seed cotton from the production of each plot of a strain to give a composite sample for the estimation of ginning percentage of each strain. This procedure leads to saving in time and labour. A significant positive regression of ginning on yield was found in the case of one experiment. The Barberton results are compared with those obtained by workers in the U.S.A. and India.

VI. THE DETERMINATION OF STAPLE LENGTH IN SINGLE PLANT SELECTIONS AND VARIETY TRIALS. A study of different methods of staple-length measurement of material from a cotton variety trial, of the comparative accuracy of three persons' measurements and of the number of seeds which it is necessary to measure in order to achieve various degrees of accuracy in the determination of differences in variety trial and single plant material, is described. If, in making single plant selections, the breeder is satisfied with a level of significance of $P=0 \cdot 1$ when using a sample of only five seeds per plant, he would be justified in discarding material falling one and a half millimetres below the standard of staple-length at which he was aiming. If, in the determination of staple-length in variety trials, the breeder is satisfied with a level of significance of $P=0 \cdot 05$, then, to detect differences of 1 mm. between varieties, it would be sufficient to measure five seeds from each of ten replicates. Samples for staple-length measurement should be taken from individual plots and not from the pooled product of all plots of a variety. It proved possible for a trained research worker to teach European lay assistants the technique of measuring so that they obtained data strictly comparable with each other's and with that obtained by their instructor.

(Cf. Abs. 466, Vol. XVI, 1939, 266, Vol. XVII, 1940, and 253, Vol. XXV., 1948, of this Review.)

390. FUZZY LEAF IN COTTON AND ITS ASSOCIATION WITH SHORT LINT. By D. M. Simpson. (*J. Hered.*, **38**, 1947, p. 153. From *Pl. Bre. Abs.*, xviii, **1**, 1948, p. 108.) A mutant with a dense pubescence on the external surfaces of the plant is reported in Upland cotton. The data obtained from crosses with this mutant and two inbred strains of Upland cotton possessing almost glabrous leaves showed that the mutant character was determined by a single gene which is allelic to the gene controlling the glabrous condition. The heterozygote exhibited a readily distinguishable intermediate pilosity. The mutant also possesses a very short fibre. The pilose character and short fibre have been found to be very closely associated, suggesting that both characters are due to the pleiotropic effects of a single gene.

391. COTTON ROOT ROT: RECOVERY OF COTTON. (*59th Ann. Rpt. Texas Agr. Exp. Sta.*, 1946.) Cotton plants attacked by the fungus *Phymatotrichum omnivorum*, the causal organism of cotton root rot, do not necessarily die from the disease. In many cases healthy plants attacked by the fungus have survived the attack. This survival is usually accompanied by the development of callus tissue in the region of the lesion caused by the fungus and by the enlargement of lateral roots arising above the infected parts. An experiment was performed by the Station to reveal the relationship between the ability of cotton roots to form effective calluses after mechanical amputation of the main or tap root, and after being attacked by the root-rot fungus. The experimental plants were of six different physiological types. Three experimental treatments were employed to vary the carbohydrate levels: high carbohydrate level, produced by removal of all lateral buds; intermediate level, obtained by permitting normal fruiting and growth; and low level, produced by fruiting and by removing half of each leaf blade. Half of the plants in each of these three classes were supplied with a low or limited supply of nitrogen, while the other half received a high or abundant supply of inorganic nitrogen. These experimental treatments resulted in six distinctly different types of cotton plants when judged by the usual standards of growth, or boll loads, which they supported. Increasing either the nitrogen or the carbohydrate level caused increased growth and fruiting. When the plants had entered into the fruiting phase of growth, they were either saved as normal controls, inoculated with root rot, or had their tap roots completely severed three inches

below the soil line by the use of bone snips. The plants were then allowed to continue their development under the experimental treatments. Final data were taken on boll load, callusing, and reaction to the root rot inoculations. The data show that the nutritional factors favouring increased growth and fruiting have equally favourable effects on callus development, enlargement of the lateral root system, and on recovery from attack by the root-rot fungus. The amount of fruiting and the rate of callusing are increased while the mortality from root rot is decreased by the factors favouring adequate accumulation and storage of reserves in the vegetative tissues. These same reserves may apparently be used in fruiting, growth, or in callusing; and they likewise increase the probability that the plant will survive if attacked by root rot.

392. IMPROVING WILT RESISTANCE AND YIELD OF COTTON BY ROGUING AND SELECTION. By J. R. Cotton. (*Phytopathology*, 37, 1947, p. 432. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 108.) A strain with a low degree of wilt resistance, derived from the cross D. and P.L.-Dixie Triumph, was rogued and selected under conditions of severe wilt infection. Bulk seed was planted in 1941 and roguing effected at ten-day intervals; the lint characters of 300 plants were studied, and from these 100 plants were selected for planting in 1942. The same procedure was repeated in the 1942 and 1943 season. In 1944 four strains were selected for increase and testing. Progeny No. 47-3-7-9 was graded the best in 1946, having a lint percentage of 37·7, boll size of 85 bolls per pound, and lint length of 1 in. Progeny No. 33-2-9-10 ranked second, having a lint percentage of 39·7, boll size of 80 bolls per pound, and lint length of $1\frac{1}{16}$ in. Both strains showed at least 98 per cent. wilt resistance. The original strain had only 35 per cent. wilt resistance, a lint percentage of 35·9, boll size of 88 bolls per pound, and lint length of 1 in.

393. MÉTHODE GÉNÉRALE D'ÉTUDE DES CARACTÈRES TECHNOLOGIQUES DES FIBRES TEXTILES VÉGÉTALES. By O. Roehrich. (*Coton et Fibres Trop.*, 1947, pp. 37, 81, 115. From *Summ. Curr. Lit.*, xxviii, 6, 1948, p. 150.) A review is presented of experimental testing procedures for cotton fibres, based mainly on work done at the Shirley Institute. The following subjects are dealt with separately: (1) Morphology and structure of the cotton hair; (2) Fineness of the fibre and degree of maturity; Spinnability; (3) Breaking load; (4) Classification of grades; (5) Evaluation of seed cotton. There are over fifty references to the literature.

394. COTTON FIBRES: EFFECT OF RAINFALL ON STAPLE LENGTH. By J. E. Caramelli. (*Algodon*, No. 131-32, 1946. In Spanish. From *Summ. Curr. Lit.*, xxviii, 4, 1948, p. 98.) A review of the literature shows the importance of the effect of rainfall on the fibre length of cotton. Results are reported of investigations carried out over a period of five years at six experimental stations in Argentina with a number of cotton varieties. The conditions were such that annual variations could not be attributed to a deterioration of the purity of the seed. The data obtained confirm the view that rainfall has an appreciable influence on the length of cotton fibres.

395. COTTON FIBRES: NITROGEN CONTENT AND FIBRE PROPERTIES. By F. M. Eaton. (*Text. Res. J.*, 17, 1947, p. 568. From *Summ. Curr. Lit.*, xxviii, 3, 1948, p. 65.) By means of simple correlation coefficients, comparisons have been made between variations in the total nitrogen content of cotton fibres and in the physical properties of these fibres and their yarns. The investigation included a total of 248 Upland and 66 Sea Island cottons. The effect on nitrogen accumulation in lint of factors such as drought, shade, various kinds of plant mutilations, and its relationship with nitrogen and carbohydrate levels in the leaves and other parts of the plant, are also considered. The results are summarized in tables.

396. NEW DYE TECHNIQUE SHOWS MATURITY OF COTTON. By C. F. Goldthwait *et al.* (*Text. World*, 97, 7, 1947. From *Text. Tech. Digest*, 4, 12, 1947, p. 506.) A clear identification of thick-walled and thin-walled cotton is obtained by a technique which dyes each a different colour in the same dyebath. Neps and other mill troubles from thin-walled cotton may be distinguished by means of this differential dyeing technique.

397. A SURVEY OF STUDIES ON POLYPLOIDY. By H. Kihara. (*Bot. and Zool.*, 7, 1939, p. 123. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 42.) A historical survey is given of research on polyploidy with comments on terminology and definitions of the phenomenon and on its cytological basis. The significance of homology of the chromosomes in regard to polyploidy, and methods of inducing polyploidy in plants and animals are also treated.

398. APOMIXIS IN HIGHER PLANTS: II. THE CAUSAL ASPECT OF APOMIXIS. By A. Gustafsson. (*Acta. Univ. Lund.*, 43, 1947, p. 71. From *Pl. Bre. Abs.*, xviii, 1, 1948, p. 44.) Part II of this comprehensive review of the nature of apomixis contains chapters on chromosome numbers and meiosis in apomictic breeding systems, the genetical background of apomixis, the physiological basis of apomixis, and apomixis in relation to sexual reproduction, diœcism and self-sterility.

[*Cf.* Abstr. 118, Vol. XXV of this Review.]

399. COLCHICINE, ITS CHEMICAL AND BIOLOGICAL PROPERTIES. (*Nature*, 10/4/48, p. 554.) The sessional inaugural lecture to the Chemical Society of University College, Dublin, was delivered on February 3 by Prof. J. W. Cook, Regius Professor of Chemistry, University of Glasgow, who spoke on colchicine. Colchicum, a drug of great antiquity, is extracted from meadow saffron (*Colchicum autumnale*). It is present in all parts of the plant, especially in the seeds, which contain up to 0·75 per cent. of the active principle. The poisonous nature of colchicum was known to Dioscorides; its toxic symptoms and its only therapeutic use, in the treatment of gout, are described in *The Herball* by John Gerarde, published in 1597. Colchicine, the active principle of colchicum, was isolated by Pelletier in 1820, but was not obtained pure and crystalline until 1915. Its composition and its functional groups were investigated by Zeisel, and the main features of its molecular structure were established by Windaus in 1924. Colchicine, $C_{22}H_{25}O_6N$, contains three rings, one of them a trimethoxylated benzene ring, an acetylamino group, and an inert carbonyl group, and it is the methyl ether of an enol. Recent studies have shown that revision of the Windaus structure is necessary, and the molecular formula of a degradation product, deaminocolchinol methyl ether, has been established beyond doubt by Barton, Cook and Loudon (1945). The final details of structure of colchicine itself still require to be settled. The molecule probably contains at least one seven-membered carbon ring. The remarkable effect of colchicine in arresting mitosis in nuclei at the metaphase was discovered by Lits, a pupil of Dustin; it is effective in a dilution of 1 in 10^8, and has important biological applications. Thus, it may be used as an index of the rate of growth of tissues, and of the activity of various classes of growth-stimulating hormones. An effect on plants, first studied by Havas, was shown by extensive investigations of Blakeslee to result in the production of polyploidy leading to new and improved varieties of flowers, fruits, and cereals.

FIBRES, YARNS, SPINNING, WEAVING, ETC.

400. INDUSTRIAL FIBRES. Commonwealth Economic Committee. (H.M. Stat. Off., 1948. Price: 5s. net.) A summary of figures of production, trade and consumption relating to cotton, wool, silk, flax, jute, hemp, mohair, coir, and rayon, in certain Commonwealth and foreign countries. Information on cotton is given under the headings: War-time control in the United Kingdom; Acreage; Production; Unit yield; Cotton varieties; Exports; Importance of Cotton in Export Trade; Imports; the Commonwealth as a Unit; United Kingdom Imports; Consumption; Stocks; Prices.

401. COTTON BALE FIRES: PREVENTION. By N. O. Clark. (*Chem. and Indus.*, 1948, p. 22. From *Summ. Curr. Lit.*, xxviii, 3, 1948, p. 71.) It is claimed that cotton bales, when dusted with sodium bicarbonate powder, are resistant to ignition by sparks or match flames because of the release, at elevated temperatures, of carbon dioxide gas.

402. CARBOXYMETHYLATED COTTON: PROPERTIES. By J. D. Reid and G. C. Daul. (*Text. Res. J.*, 17, 1947, p. 554. From *Summ. Curr. Lit.*, xxviii, 3, 1948, p. 62.) With the object of preparing a quickly swellable cotton so that the permeability of the cloth to water would be decreased, cotton fibres have been partially carboxymethylated. In general, cotton (fibres or yarns) was impregnated with a solution of monochloroacetic acid and then treated with concentrated sodium hydroxide. The degree of substitution may be varied by change in conditions, and is conveniently estimated by preparing the insoluble copper salt of the carboxymethylcellulose and then determining the copper content. With degrees of substitution of about one carboxyl group per fifteen glucose residues or less, the treated yarns do not vary greatly in strength, handle, appearance, or moisture content from mercerized controls. Swelling capacity and water retention, however, are greatly increased. Resistance to rotting is also increased by replacement of the Na by Cu, Hg, or Ag. There are twenty-five references to the literature.

403. THE ACIDIC PROPERTIES OF COTTON CELLULOSE AND DERIVED OXYCELLULOSES. PART I. By C. F. Davidson and T. P. Nevell. (*J. Text. Inst.*, xxxix, 3, 1948, T59.) This paper gives an introduction to, and a general review of, work described in detail in five following papers concerned with a critical and comparative examination of different methods for the quantitative determination of carboxyl groups in oxycelluloses. The following are the headings of the various papers: Part II. The Absorption of Methylene Blue. Part III. Ion-exchange Reactions with various Cations. Part IV. Absorption of Silver from Silver Nitrophenate Solutions. Part V. A Comparison of Various Methods proposed for the Determination of Carboxyl Content. Part VI. Application of the Lefevre-Tollens Method for the Estimation of Uronic Acid Groups.

404. COTTON FIBRE: DETERMINATION OF ORIGINAL DIAMETER AND POROSITY. By K. R. Sen. (*J. Sci. Club* (Bengal), 1, 2, 1947, p. 37. From *Summ. Curr. Lit.*, xxviii, 4, 1948, p. 97.) It is considered unlikely that the swollen diameter of a cotton fibre in 18 per cent. caustic soda should be identical with the original cell diameter. By preventing the outward swelling and the consequent stretching of the cuticle, while the internal swelling is not interfered with, it is possible to estimate the original diameter of the fibre cell. The outward swelling is prevented by fixing the ends of the straightened fibre firmly before treatment with 18 per cent. alkali. The value of the original cell diameter thus obtained is found to be equivalent to the mean maximum ribbon width of the collapsed fibre taken at points where the ribbon is fully spread out. The original cell diameter is used to develop an empirical technique for calculating the pore space in the wall of a cotton fibre as percentage of the total wall volume. The calculated values of porosity exhibit generally a direct linear relationship with pliability per unit length. Estimations of "free" and of "bound" moisture show that as cottons with increasing pore-space are encountered, "free" moisture decreases until a pore-space of 19 per cent. is reached, and increases thereafter; on the other hand, "bound" moisture increases with pore-space up to the 19 per cent. limit and decreases thereafter with increasing pore-space. This indicates the possibility that the pores in the cotton fibre wall increase up to 19 per cent. of wall space through increase in the number of cavities of narrow dimensions, while for fibres possessing a porosity greater than 19 per cent. the pore volume increases mainly by extension of the pore dimensions.

405. COTTON FIBRES: EFFECT OF REAGENTS ON PHYSICO-CHEMICAL CONDITION. By P. P. Viktorov. (*J. App. Chem.*, U.S.S.R., 19, 1946, p. 900. From *Summ. Curr. Lit.*, xxviii, 4, 1948, p. 98.) Unbleached medical gauze was exposed to the action of inorganic or organic reagents and dried by pressing with an iron heated to 120° C. The gauze was boiled with the inorganic reagents in a flask equipped with a reflux condenser or heated with the organic reagents in a soxhlet extractor. Evidence of physico-chemical change was obtained by analysing the cotton for waxes, pectins, and nitrogenous substances, by microscopic examination employing cuprammonium reagent, by determining the capillary rise in the fibre, and by measuring the

tenacity of the fibres. Two different modes of action can be distinguished. The vapours from mixtures of organic reagents with water have little or no effect on the structure or chemical nature of the fibres. On the other hand, vapours from the solutions of inorganic reagents produce extreme chemical changes in cotton fibres. The inorganic reagents destroy the external sheath of the cotton fibre and render the inner part of the fibre accessible to attack. The natural impurities in the cotton are removed to a significant degree. In addition, the tensile strength of the fibres is markedly reduced. The heat of swelling of cotton fibres in aqueous alcohol was determined at several alcohol concentrations. It reached a maximum at approximately 40 per cent. ethanol.

406. AN ELECTRICALLY HEATED NEEDLE FOR MOUNTING COTTON FIBRES WITH WAX. By A. N. Gulati. (*Ind. Cott. Grwg. Rev.*, 11, **1**, 1948, p. 23.) An illustrated description of the needle.

407. COTTON LINTERS: PURIFICATION WITH CONCENTRATED ALKALI. By Hercules Powder Co. (Assignees of L. D. Callanas. B.P. 593,768 of 11/6/45; 24/10/47: Conv. 3/5/44. From *Summ. Curr. Lit.*, xxviii, **3**, 1948, p. 54.) It is claimed that a better product is obtained from cotton linters by steeping the raw material in relatively concentrated caustic alkali at room temperature, without leading to mercerization (*e.g.*, 9 per cent. NaOH at 25° C. for 45 minutes; 20:1 ratio), before the usual pressure scour and bleach. The value of the process is demonstrated by measurements of " clarity " and colour (Lovibond scale) and counts of palisade cells (from cottonseed) in cellulose acetate dopes made from ordinary and the new pulps.

408. COTTON LINTERS: STRUCTURE. By C. W. Hock. (*Text. Res. J.*, **17**, 1947, p. 423. From *Summ. Curr. Lit.*, xxviii, **3**, 1948, p. 65.) The microscopic structure of the fibres in cotton linters is similar in many respects to that of staple cotton. The thin primary wall consists largely of waxy and pectic materials. The thick secondary wall is arranged in layers. In some linters this layered pattern is due to the alternation of layers of cellulose with layers of non-cellulosic material. The width of the individual layers varies roughly between 0·1 and 0·4 micron in unswollen fibres. The cellulosic layers are further subdivided into fine thread-like fibrils which make an acute angle with respect to the long axis of the fibre. The orientation of the fibrils is not the same in all layers and may even reverse its direction of spiral in a single layer. These structural characteristics influence the manner of swelling. A number of photomicrographs are shown.

409. COTTON MILL: AIR CONTAMINATION. By L. Silverman. (*Text. Indus.*, **111**, 1947, pp. 84, 152. From *J. Text. Inst.*, xxxviii, **12**, 1947, A594.) Health hazards associated with the cotton industry and their relation to the problem of air-borne dust and lint control are briefly mentioned. The principal materials which cause air contamination are the " pepper trash " (small leaf particles), inorganic dust, and the short cotton fibres. Data are tabulated on the air contamination during various operations in a representative cotton textile mill. The control of dust and airborne lint by direct methods such as oiling or moisture conditioning of cotton, by more extensive cleaning of the cotton at the gin, and by various ventilation procedures, is discussed.

410. COMBED COTTON YARN: INFLUENCE OF FIBRE PROPERTIES ON QUALITY. By R. W. Webb and H. B. Richardson. (*Text. World*, **97**, 10, 1947, pp. 145, 208. From *Summ. Curr. Lit.*, xxviii, **3**, 1948, p. 55.) This article summarizes the main conclusions presented in the paper " Relation and Importance of Certain Fibre Properties of Long Staple Cottons to Strength and Appearance of Combed Yarns, and to Percentages of Manufacturing Waste," published by the U.S. Department of Agriculture. Tables of experimental data obtained with 60s and 100s yarn are presented, and a formula is included for determining the approximate breaking load of any count of combed cotton yarn when 18 per cent. waste is removed by the comber.

411. RAW COTTON: GRADING AND FIBRE TESTING. By S. Carter. (*Text. World*, **97**, 1947. No. 11, pp. 110, 216. From *Summ. Curr. Lit.*, xxviii, **3**, 1948, p. 66.)

The author gives a short summary of a U.S. Department of Agriculture bulletin "Cotton Mills Requirements as related to Improved Cotton Quality and Marketing Practices" (July, 1947). The value of routine fibre testing is stressed as supplementing regular classing, and tables are presented showing how fibre length, uniformity, strength and impurity content results obtained by the two procedures may be co-ordinated.

412. Textile Terms and Definitions. (*J. Text. Inst.*, xxxviii, 12, 1947, p. 615.) Contains the first list of definitions approved for publication by the Textile Terms and Definitions Committee, given under the heading of "Recommended as Standard." A number of tentative terms are also included for comment.

[*Cf.* Abstr. 165, Vol. XXIII of this Review.]

THE EMPIRE COTTON GROWING REVIEW

VOL. XXV OCTOBER, 1948 No. 4

TWENTY-FIVE YEARS

WITH this number the EMPIRE COTTON GROWING REVIEW completes its twenty-fifth volume; Volume I, Number 1, was issued in January, 1924, a time of recovery and hope, and the journal appeared quarterly without break to the end of Volume XVI, under the editorship of Dr. J. C. Willis, F.R.S. When war with Germany was renewed a break in continuity seemed inevitable, and the number for October, 1939, completing Volume XVI, enclosed a notice that publication, for reasons which seemed decisive, would cease for the duration. Experience soon began to show that one of these reasons, the fear that the inflow of literature bearing on cotton production would diminish to a trickle or stop, was not well founded. Cotton is a munition of war and its continued production was essential. On second thoughts it was decided to continue to publish the abstracts of current literature which we were assured, in answer to such enquiries as we were able to make, were appreciated by those of our readers concerned. From June, 1940, to December, 1945, two Abstract Numbers a year were issued. In April, 1946, publication in full was resumed, except that three numbers only were issued in order to get back to the calendar year.

At the end of the first ten years of the journal's existence we published (Vol. X, p. 255) an editorial review of the volumes so far issued, which consisted essentially of a combined and classified index of the original articles they contained. A review of the volumes which have since appeared is convincing that there is much within them that is well worth re-perusal, and much that is useful for reference. As no combined index, and indeed no separate annual index of original matter, is available, we have decided to continue this feature from the tenth volume onward.

Reviews of the work of the Empire Cotton Growing Corporation in a wider sense have been published from time to time and an appreciation by Sir John Russell of the Corporation's activities and achievements during the twenty-five years of its existence has recently appeared.

EMPIRE COTTON PRODUCTION

Editorial: The Second Conference of Workers on Cotton-growing Problems, XI, 1934, p. 263.

CURRIE, J.: Empire Cotton Production: A Review of Progress, XIII, 1936, p. 171.

KILLBY, L. G.: Helping to Build an Empire Industry, XIV, 1937, p. 1.

Editorial: The Third Conference of Workers on Cotton Growing Problems, XVI, 1940, p. 1.

RUSSELL, E. J.: Twenty-five Years of the Corporation's Activity, XXIV, 1947, p. 1.

Editorial: Twenty-five Years, XXV, 1948, p. 243.

In the above-mentioned review of the " First Ten Years " the maximum output of Empire-grown cotton (excluding India) was recorded as 480,727 bales of 400 lb. in 1931-32. In the later period the maxima have increased to 884,298 bales in 1937-38 and 882,316 in 1940-41, an achievement largely due to expansion in the Sudan and in Uganda. While production on this scale is small in relation to world supplies, it has had a greater significance than the figures suggest, and can, with good authority, be held to justify the Corporation's existence. In the fundamentally changed economic position in which we now find ourselves the production of Empire cotton, from being desirable, has become essential. If the Corporation did not exist it would be necessary to create it, or to improvise some body with similar functions, and there is urgent justification for greatly increased activity. It is indeed fortunate that there are twenty-eight years of invaluable experience from which to advance. It is to Africa that we must look for the necessary expansion, and a beginning has been made in surveying the prospects.

INCREASED COTTON PRODUCTION IN THE AFRICAN COLONIES

Editorial: Possibilities of Increased Cotton Production in East Africa, XXIV, 1947, p. 77.

PARNELL, F. R.: Expansion of Cotton Growing in the African Colonies, XXIV, 1947, p. 157.

HUTCHINSON, J. B.: Immediate Lines of Attack, XXIV, 1947, p. 164.

ANSON, R. R.: Anglo-Egyptian Sudan: Cotton Production, XXIV, 1947, p. 169.

PEAT, J. E.: Tanganyika Cotton Production, XXIV, 1947, p. 171.

DUCKER, H. C.: Nyasaland and Increased Cotton Production, XXIV, 1947, p. 239.

PEARSON, E. O.: Insect Pests as a Factor Affecting Large-Scale Cotton Growing in Africa, XXIV, 1947, p. 244.

Editorial: The Expansion of East African Cotton Production, XXV, 1948, p. 1.

MACKIE, J. R.: The Possibilities of Increased Production of Cotton in Nigeria, XXV, 1948, p. 4.

TEALE, E. O.: Undeveloped Land in East Africa, with Special Reference to Tanganyika, XXV, 1948, p. 12.

SCIENCE IN APPLICATION TO COTTON GROWING

Foremost in the scientific services essential to successful cotton growing comes the work of the plant breeder in adjusting the cotton plant to its particular environment, increasing and stabilizing its yield,

and developing its qualities in relation to the spinner. Moreover, experience with most or all crops shows that however conservative the grower, there is less difficulty in persuading him to adopt improvement in this direction than in any other.

Prominent in the papers on this subject is the episode in which Dr. T. G. Mason trailed his coat in front of the cotton plant breeders in a " Note on the Technique of Cotton Breeding." The modesty of the title and the mildness of expression did not wholly conceal the criticism implied, and the quick reactions in defence suggested that some tender spots had been touched.

PLANT BREEDING

HARLAND, S. C.: The Work of the St. Vincent Cotton Station, XI, 1934, p. 300.

PARNELL, F. R.: The Origin and Development of U4 Cotton, XII, 1935, p. 177.

AYYAR, V. R.: An Inexpensive Method of Selfing Cotton Flowers, XIII, 1936, p. 28.

BROWN, C. H.: The Correlation of Certain Characters in Egyptian Cotton, XII, 1935, p. 216.

HURST, C. C.: Recent Work in Plant Breeding, XIII, 1936, p. 99.

FIELDING, W. L.: The Organization of Native Staffs on an African Experiment Station, XIII, 1936, p. 200.

MASON, T. G.: A Note on the Technique of Cotton Breeding, XV, 1938, p. 113.

EVANS, G.: Note on Dr. Mason's article on the Technique of Cotton Breeding, XV, 1938, p. 118.

TEMPLETON, J.: A Reply to Dr. Mason's Note on the Technique of Cotton Breeding, XV, 1938, p. 228.

PRENTICE, A. N., and PEAT, J. E.: Comments on Dr. Mason's Note on the Technique of Cotton Breeding, XV, 1938, p. 301.

RAMIAH, K., and PANSE, V. G.: A Reply to Dr. Mason's Note on the Technique of Cotton Breeding, XVI, 1939, p. 25.

HARLAND, S. C.: Some Comments on Dr. Mason's Article, XVI, 1939, p. 186.

HUTCHINSON, J. B.: Note on a Policy of Introduction of New Varieties of Cotton in Africa, XV, 1938, p. 283.

HUTCHINSON, J. B.: Some Problems in Genetics whose Solution would help the Plant Breeder, XV, 1938, p. 286.

JAMESON, J. D.: Plant Selection in Native Cotton Plots, XV, 1938, p. 295.

BROWN, C. H.: Selection and Hybridization, XVI, 1939, p. 111.

HUTCHINSON, J. B.: Selection and Hybridization (Comment), XVI, 1939, p. 205.

HUTCHINSON, J. B.: Letters to a Critic, I, XXIV, 1947, p. 90.

FIELDING, W. L.: Hybridization Technique with Cotton, XXIV, 1947, p. 207.

BROWN, C. H.: Egyptian Cotton Breeding Technique, XXV, 1948, p. 35.

KING, H. E.: Percentage of Short Hairs as a Character of Importance in Barberton Cotton Samples, XXV, 1948, p. 277.

KING, H. E., and MUNRO, J. M.: A Method of Determining Hair Weight of Cotton, XXV, 1948, p. 271.

GENETICS

GATES, R. R.: The Cytological Study of Cotton and its Relatives, XI, 1934, p. 194, and XII, 1935, p. 38.

Editorial: Chromosomes and the Work of Professor Ruggles Gates, XII, 1935, p. 95.

GATES, R. R.: The Origin of Cultivated Cotton, XV, 1938, p. 195.

An encouraging feature of the progress made in the period under consideration is the success already attained, and the promise of further success by the plant breeder in avoiding some of the most serious losses due to pests and diseases. The threat to the industry in the Sudan from leaf curl has been largely removed by this means. The menace to cotton grown in many regions in Africa from the insect we know in brief as Jassid, which was largely responsible for checking development in southern Africa, has been overcome already in the older areas of its prevalence, and the way made clear to the same end where it has assumed more recent importance. Work which may well become classical is in progress to provide immunity from damage by the cosmopolitan bacterium responsible for angular leafspot, blackarm, and bacterial boll disease.

The cotton plant has much more than would appear to be its due share of pests, and many remain, some serious, which must be attacked or avoided in other ways. The need for increased production increases their importance, and fortunately a new range of potent insecticides opens new prospects of control if means can be found for their general provision and application. The attention that pests and diseases have attracted is reflected in the following list of papers. A subject related in a sense to that of insecticides is that of chemical control of weeds, which has no present relation to cotton, but may well assume it in the future.

Pests and Diseases

Williams, C. B.: The Cotton Stainer Problem, XI, 1934, p. 99.

Thompson, W. R.: The Biological Control of Injurious Insects and Plants, XI, 1934, p. 180.

Massey, R. E.: Studies on Blackarm Disease of Cotton, III, XI, 1934, p. 189.

Bailey, M. A.: Leaf Curl Disease of Cotton in the Sudan, XI, 1934, p. 280.

Uvarov, B. P.: Locusts and a Rational Anti-Locust Policy, XII, 1935, p. 193.

Harris, W. V.: Termites and Cotton Growing, XIII, 1936, p. 121.

Howard, A.: The Rôle of Insects and Fungi in Agriculture, XIII, 1936, p. 186.

Editorial: Pests and Diseases, XIII, 1936, p. 257.

Bebbington, A. G., and Allan, W.: The Pest and the Plant, XIV, 1937, p. 31.

Harland, S. C.: The Rôle of Insects and Fungi in Agriculture, XIV, 1937, p. 52.

Howard, A.: Insects and Fungi in Agriculture, XV, 1938, p. 215.

Golding, F. D.: Notes on the Insect Pests of Cotton in Nigeria, XV, 1938, p. 224.

Andrews, F. W.: The Effect of Leaf Curl Disease on Yield, XIII, 1936, p. 287.

Massey, R. E.: Seed Disinfection, with Special Reference to Cotton, XIV, 1937, p. 301.

Hansford, C. G., and Hosking, H. R.: Recent Research in Uganda on Blackarm Disease, XV, 1938, p. 7.

Munro, J. W.: Diseases and Pests of Cotton, XVI, 1939, p. 12.

Nowell, W.: Internal Boll Disease, XVI, 1939, p. 18.

Squire, F. A : A Note on the Hosts of the Pink Bollworm in the West Indies, XVI, 1939, p. 194.

SQUIRE, F. A.: A Note on the Resistance of *Hibiscus esculentus* and *Gossypium trilobum* to Pink Bollworm, XVI, 1939, p. 268.

GOLDING, F. D.: The Occurrence of *Platyedra gossypiella* Saund. in Nigeria, XXII, 1945, p. 1.

GARRETT, S. D.: Report on an Investigation of *Verticillium* Wilt., XXIV, 1947, p. 101.

RAINEY, R. C.: Habari ya Nzige, XXV, 1948, p. 254.

INSECTICIDES AND WEED KILLERS

MASON, T. G., and PHILLIS, E.: A Note on a New Method of Control for Insect Pests, XIV, 1937, p. 308.

PHILLIS, E., and MASON, T. G.: Observations on the Selenization of Cotton under Field Conditions in Trinidad, XV, 1938, p. 290.

PAGE, A. P. B.: Insecticides and their Application, 1939-45, XXIII, 1946, p. 90.

PAGE, A. B. P.: Insecticides and their Application, 1945-47, XXV, 1948, p. 102.

HALLIDAY, D. J.: Selective Weed Control by Chemical Means, XXV, 1948, p. 173.

The third approach to cotton growing problems is through the agricultural requirements of the crop, some questions relating to which are discussed in the papers listed below. The fact that cotton cultivation is regarded as particularly liable to accelerate soil erosion lends some relevant emphasis to the three papers on that subject.

COTTON AGRONOMY

WOOD, R. C.: Potash Starvation and the Cotton Plant, I and II, XI, 1934, p. 25, and XV, 1938, p. 30.

JACKSON, F. K., WAD, Y. D., and PANSE, V. G.: The Supply of Humus to Soils, XI, 1934, p. 111.

WOOD, R. C.: Cotton Rotations, XIII, 1936, p. 92.

SINGH, B. N., and CHOUDHRI, R. S.: The Rôle of " Deflowering " in Cotton Production, XIV, 1937, p. 126.

CROWTHER, F.: Manurial Requirements of Cotton Varieties, XV, 1938, p. 21.

HOWARD, A.: The Mycorrhizal Relationship in Cotton Production, XV, 1938, p. 310.

MARTIN, W. S.: Soil Fertility, XXIV, 1947, p. 9.

SOIL EROSION

STOCKDALE, F. A.: Soil Erosion, XII, 1935, p. 1.

SAMPSON, H. C.: Soil Erosion in Tropical Africa, XIII, 1936, p. 20.

HALL, D.: Soil Erosion: The Growth of the Desert in Africa and Elsewhere, XV, 1938, p. 1.

A section of botanical science which is far from having reached its due development in application to the growth and well-being of crops is plant physiology. It is capable of valuable, we might say essential, contributions to plant breeding, to pest and disease control and to agronomy. One of the papers below reminds us of the importance of the least studied part of the crop plant, the root. The last paper supplies a present-day estimate by Professor V. H. Blackman of the place of plant physiology in crop research.

CROP PHYSIOLOGY

MASON, T. G., and PHILLIS, E.: A Tentative Account of the Movement of Food Materials during the Development of the Cotton Plant, XI, 1934, p. 121.

PHILLIS, E.: Progress in Physiology, XIV, 1937, p. 117.

SINGH, B. N., and CHOUDHRI, R. S.: The Effect of Visible, Ultra-violet and Infra-red Radiations upon the Germination and the Therapeutic Treatment of Cotton Seed, XV, 1938, p. 35.

HAMID, M. A.: Longevity of Cotton Seeds Delinted with Sulphuric Acid, XV, 1938, p. 312.

HEATH, O. V. S.: Water-logging and Soil Aeration in Relation to the Growth of Cotton and Other Plants, XVI, 1939, p. 104.

SAMPSON, H. C.: Roots, XVI, 1939, p. 166.

BLACKMAN, V. H.: The Place of Plant Physiology in Crop Research, XXV, 1948, p. 91.

There is another side of the application of science to cotton growing which is not agricultural but has an essential relationship to cotton plant breeding and the marketing of raw cotton. Only those workers overseas who tried before the development of the current services of the Shirley Institute to adjust their selections to the undefined and apparently undefinable requirements of the broker and the spinner can fully appreciate the value of the present co-operation with the cotton technologist and of the services which he provides. An imaginative and humorous description of the pre-Shirley predicaments of the remote cotton plant breeder begins the article "What Kind of Cotton *do* they Want?" The question had often to be asked and the humorous side of the situation was not always evident to its victim. Matters have now advanced to the point where the technologist himself visits the countries of origin to make direct acquaintance with the problems involved and to experience the incidental difficulties which may hinder, exasperate, or even bring out the latent determination of those engaged in work in the field. This is a situation very different from that in which a cotton expert, admittedly able in his own line, when sent out to the West Indies never completely lived down his initial inability to recognize a cotton plant.

COTTON TECHNOLOGY

TURNER, A. J.: The Spinning Value of Cotton, XI, 1934, p. 10.

TURNER, A. J.: Cotton and Rayon, XII, 1935, p. 199.

POYNTER, H. G., and BROWN, D. H.: Grading of Improved Ishan Cotton, XIII, 1936, p. 193.

SHEFFIELD, F. M. L.: The Early Development of the Cotton Fibre, XIII, 1936, p. 277.

PIERCE, F. T.: What Kind of Cotton *do* they Want? XIV, 1937, p. 286.

TURNER, A. J.: Factors of Cotton Quality, XV, 1938, p. 187.

WADSWORTH, H. E.: Current Trends in the Use of Cotton, XVI, 1939, p. 91.

BAILEY, M. A., Halo-length Measurement, XVI, 1939, p. 272.

LORD, E.: A Textile Technologist in the Cotton Field, I and II, XXIII, 1946, pp. 83 and 163.

LORD, E.: On the Grade and Staple of Cotton, XXIV, 1947, p. 186.

SARAIYA, R. G., and LORD, E.: Correspondence on the Grade and Staple of Cotton, XXV, 1948, p. 48.

LORD, E.: Shots in the Dark, XXV, 1948, p. 20.

LORD, E.: Neppiness and Immaturity in Cotton, XXV, 1948, p. 180.

TODD, J. A.: The Uses of Cotton Seed, XII, 1935, p. 278.

To conclude this section of papers dealing with the more specific applications of science to cotton production we may appropriately group a series of articles describing the institutions which either exist for this purpose or in various ways and to different degrees contribute to it.

INSTITUTIONS

PICKARD, R. H.: The Shirley Institute, XII, 1935, p. 9.

LINDSAY, H.: The Imperial Institute, XII, 1935, p. 269.

BALLS, W. L.: Giza, XII, 1935, p. 286.

SKEETE, C. C.: The West Indian Sea Island Cotton Association, XIII, 1936, p. 178.

CHADWICK, D.: The Imperial Agricultural Bureaux, XIV, 1937, p. 93.

NOWELL, W.: The First Ten Years of the Amani Research Station, XIV, 1937, p. 101.

TOY, F. C.: The Shirley Institute—In Peace and War, XXIII, 1946, p. 157.

EVANS, G.: The Royal Botanic Gardens, Kew, XXIV, 1947, p. 18.

Editorial: Agricultural Research in East Africa, XXV, 1948, p. 83.

BURT, B., and MAHTA, D. N.: The Indian Central Cotton Committee and its Work, XV, 1938, p. 93.

EVANS, G.: Recent Developments in Training for Agricultural Service in the Tropics, XVI, 1939, p. 83.

BALLS, W. L.: Twenty Years in the Cotton Research Board at Giza, XXV, 1948, p. 262.

REGIONAL COTTON GROWING

The conclusion has long been accepted that the expansion of Empire cotton production to adequate proportions must depend almost entirely upon developments in the African continent. As already mentioned, the notable increase in the fifteen years since the previous review has come mainly from production in the Sudan and Uganda. If expansion on an altogether larger scale is demanded it is mainly to the tropical dependencies of East and West Africa that effort must be directed. It is further possible that the establishment of spinning mills in South Africa and Rhodesia may lead to renewed production in the south, for which the way has been long prepared by the work of the experiment stations at Barberton and Gatooma.

This situation gives a renewed interest to the papers descriptive of past experience in these regions, and since it is further accepted that in the tropical areas increased cotton production must depend upon the native cultivator, whose agricultural systems must be developed to achieve it, the articles which deal with various aspects of native agriculture have an especial importance. Some continuations of the

regional accounts will be found in a later section of this index under " Cotton in the War Years."

Cotton Growing in Central and Southern Africa

Cameron, G. S.: Cotton in Southern Rhodesia, XI, 1934, p. 98a.

Clay, G. F.: Cotton Growing in Uganda, I and II, XI, 1934, pp. 173, 289.

Lochrie, J. V.: Cotton in Swaziland, XII, 1935, p. 183.

Harrison, E.: Cotton in Tanganyika Territory, XIII, 1936, p. 1.

Browne, G.: Cotton in Northern Nigeria, XIII, 1936, p. 12.

Cameron, G. S.: Some Aspects of the Promotion of Cotton Growing in Southern Rhodesia, XIV, 1937, p. 24.

Milligan, S.: Some Cotton Problems of South Africa, XIV, 1937, p. 189.

Ducker, H. C.: Cotton in Nyasaland, XV, 1938, p. 201, XXIII, 1946, p. 4.

De Bauw, A. C.: Cotton Growing in the Belgian Congo, XIV, 1937, p. 277.

Sennitt, R. S.: Treatment and Quality of Cotton in the Belgian Congo, XXIV, 1947, p. 258.

African Native Agriculture in Relation to Cotton

Wakefield, A. J.: Mixed Farming and Peasant Holdings in Tanganyika Territory, XI, 1934, p. 87.

Browne, G.: Some Technical Notes on the Use of Cattle at Daudawa, XIII, 1936, p. 297.

The Kingolwira Peasant Settlement Scheme, XV, 1938, p. 209.

Hoyle, S. T.: The Spacing of Cotton in Nyasaland, XV, 1938, p. 306.

Ducker, H. C.: The Time to Plant Cotton in Nyasaland, XI, 1934, p. 295.

Ducker, H. C., and Hoyle, S. T.: Some Studies on Cultivation Practices, Food Crops, and the Maintenance of Fertility at the Cotton Station, Nyasaland, XXV, 1948, p. 112.

Latham, G. C.: The Use of Films in African Agriculture, XV, 1938, p. 121.

Bradley, K.: A Cotton Market in Northern Rhodesia, XVI, 1938, p. 99.

Editorial: Native Agriculture in East Africa and its Developments, XXIII, 1946, p. 1.

Hoyle, S. T.: Picking Clean Cotton, XXIII, 1946, p. 20.

Kaumi, B. K.: A Day in the Life of a Cotton Grower (Uganda), XXIII, 1946, p. 22.

Cotton growing in the Sudan Gezira is in a category of its own, especially as regards its agricultural problems. The controversy revealed in the papers listed below on the question of the need for drainage in the Gezira concerns a subject which is probably no longer a living issue. The Sudan has been, and is, an active centre of cotton growing research, which in recent years has extended its activity more and more into the regions of rain-grown crops. In considering the type of organization which will be required to co-ordinate the efforts to increase native-grown crops in countries further south, and especially to handle their produce, attention has been directed to the working of the Sudan Plantations Syndicate as affording valuable experience in this direction.

COTTON GROWING IN THE ANGLO-EGYPTIAN SUDAN

HEWISON, R.: Some Factors affecting the Gezira Irrigation Scheme, XII, 1935, p. 25.

BALLS, W. L.: Drainage in the Sudan Gezira, XII, 1935, p. 32.

BARRITT, N. W.: Soil Fertility in the Sudan Gezira, XII, 1935, p. 111.

DEMPSTER, G. H.: Drainage in the Sudan Gezira, XII, 1935, p. 117.

GREENE, H., and BAILEY, M. A.: Drainage in the Sudan Gezira, XII, 1935, p. 208.

BALLS, W. L.: Drainage in the Sudan Gezira, XII, 1935, p. 297.

ROBERTS, W.: Drainage in the Sudan Gezira, XIII, 1936, p. 120.

INGE, E.: A Day in the Life of a Cotton Inspector in the Sudan, XII, 1935, p. 119.

CROWTHER, E. M.: Rainfall and Cotton Yields in the Sudan Gezira, XIII, 1936, p. 110.

WALLEY, V. P.: Working Cattle in the Anglo-Egyptian Sudan, XIII, 1936, p. 294.

TROUGHT, T.: Cotton Growing and Breeding in the Anglo-Egyptian Sudan, XIV, 1937, p. 197.

LAMBERT, A. R.: New Sakel Strains in the Sudan, XV, 1938, p. 14.

There are some early papers on cotton growing in India. Later work must be looked for in full in the Indian journals, and in the abstracts of Indian literature included in the Review.

COTTON IN INDIA

GILHESPY, W.: Riley takes a Hand, XI, 1934, p. 30.

TAMBE, G. C., and WAD, Y. D.: Silage Making in Mud-walled Towers, XI, 1934, p. 310.

JENKINS, W. J.: The Development of Cotton Cultivation in Sind, XIII, 1936, p. 266.

JENKINS, W. J.: Recent Cotton Legislation in the Bombay Presidency, XIV, 1937, p. 206.

SAMPSON, H. C.: Some Reminiscences of Work on the Cotton Crop, I and II, XIV, 1937, p. 294, and XV, 1938, p. 129.

BURT, B., and MAHTA, D. N.: The Indian Central Cotton Committee and its Work, XV, 1938, p. 93.

ROBERTS, W.: American Cotton in the Punjab and in Sind, XVI, 1939, p. 31.

Two articles have recently appeared dealing with the present position in the U.S.A. The first gives an account of the lines of work which are being followed at the principal centres of cotton investigation; the second describes in fuller detail the progress which has been made in the mechanization of the cultivation and harvesting of the cotton crop—a subject of particular interest where the extension of cotton production is under consideration.

The two items of U.S.A. cotton history have a value which only those who have experienced the surprising difficulty of finding information on this subject can fully appreciate.

COTTON IN THE U.S.A.

STEPHENS, S. G.: Some Recent Trends in Cotton Research in the U.S.A., XXIV, 1947, p. 28.

SMITH, H. P.: The Production of Cotton in the United States, Recent Methods, XXIV, 1947, p. 175.
Early Days of Cotton Growing in the U.S.A., XIV, 1937, p. 41.
U.S. YEARBOOK OF AGRICULTURE, 1940: History of Cotton in the United States, XXIII, 1946, p. 111.

COTTON IN OTHER COUNTRIES

PITCAIRN, A.: Cotton Cultivation in Cyprus, XII, 1935, p. 16.
ANSON, R. R.: Cotton Growing in the Fiji Islands, XII, 1935, p. 300.
TROUGHT, T.: Cotton Growing in Greece, XXV, 1948, p. 29.
CHENG, K. S.: The Tree-Cotton in Yunnan, XXV, 1948, p. 279.

Throughout the pre-war period a regular service of cotton statistics was maintained by Mr. J. A. Todd, and this has been continued in recent volumes by Mr. Dudley Windel. There is, further, a series of papers by Mr. Todd on American cotton legislation and prices.

LEGISLATION AND PRICES IN THE U.S.A.

TODD, J. A.: Finance, America, and Cotton Prices, XI, 1934, p. 1.
TODD, J. A.: American Cotton Legislation, XII, 1935, p. 103.
TODD, J. A.: American Cotton Legislation, XIII, 1936, p. 83.
TODD, J. A.: American Cotton Restriction, and its Effect on Outside Growths, XIV, 1937, p. 110.
TODD, J. A.: Finance, America, and Cotton Prices, XV, 1938, p. 105.
TODD, J. A.: Twenty-five Years of Cotton Prices, XV, 1938, p. 277.

On resuming full publication after the war period we were considerably helped to fill the gap by contributions covering some five years of cotton history from various points of view.

COTTON IN THE WAR YEARS

DUCKER, H. C.: Cotton in Nyasaland, XXIII, 1946, p. 4.
PEAT, J. E.: Cotton in Tanganyika during the Past Five Years, XXIII, 1946, p. 12.
WINDEL, D.: Developments in the World Raw Cotton Situation during the War Period, XXIII, 1946, p. 28.
ANSON, R. R.: Local Cotton History in the Sudan, 1942-46, XXIII, 1946, p. 77.
PILKINGTON, W. G.: Lancashire's Cotton Industry during the War Years, XXIV, 1947, p. 81.
WELLS, W. G.: Cotton Growing in Queensland during World War II, XXIV, 1947, p. 251.

OBITUARY NOTICES

KILLBY, L. G., and MAY, J. C.: Sir James Currie, XIV, 1937, p. 185.
KILLBY, L. G., and MAY, J. C.: Sir Richard Jackson, XXI, 1944, p. 1.
KILLBY, L. G., and ENGLEDOW, F. L.: James Stanley Addison, XXI, 1944, p. 3.
BLACKMAN, V. H., and NOWELL, W.: Sir John Farmer, F.R.S., XXI, 1944, p. 4.
TEALE, E. O.: Clement Gillman, C.B.E., An Appreciation, XXIV, 1947, p. 92.
KILLBY, L. G.: Lord Derby, XXV, 1948, p. 88.

PERSONAL

Retirement of Mr. L. G. Killby, C.M.G., XXIV, 1947, p. 237.

MISCELLANEOUS

The two papers by Dr. Martin Leake listed below deal with questions of agricultural organization and the possibilities of increased yields from agriculture which now have an urgency which could hardly have been realized in the days, equally unimaginable in retrospect, when the earlier paper could begin: " The superabundance of agricultural produce of all sorts with which the world is at the moment cluttered up . . ." !

MAHTA, P. N.: Harvesting of Groundnuts, XI, 1934, p. 209.

ROSCOE, E. C.: Oversea Mechanical Transport, XII, 1935, p. 307.

LEAKE, H. M.: Over-production or Under-consumption? XIII, 1936, p. 31.

LEAKE, H. M.: The Man and the Plant, XVI, 1939, p. 180.

EVANS, G.: Post-war Conditions in the British Caribbean Colonies, XXV, 1948, p. 161.

IN LIGHTER VEIN

SMITH, S. R.: Some West African Social Customs, XI, 1934, p. 202.

FIELDING, W. L.: War Interlude, XXIII, 1946, p. 102.

RAINEY, R. G.: Further Outlook Unsettled, XXIII, 1946, p. 172.

PEARSON, E. O.: A Journey to Tokar, XXIV, 1947, p. 197.

PEARSON, E. O.: Passenger to Chad, XXV, 1948, p. 191.

HUTCHINSON, J. B.: Whit-Monday in Lyons, XXV, 1948, p. 268.

REVIEWS

Reviews have been published of the following:

MEEK, C. K.: Land Law and Custom in the Colonies (Ed.), XXIV, 1947, p. 111.

WHYTE, R. O.: Production and Environment (Ed.), XXIV, 1947, p. 113.

PIM, ALAN: Colonial Agricultural Production: the Contribution made by Native Peasants and by Foreign Enterprise (Ed.), XXIV, 1947, p. 114.

WALOFF, Z.: Seasonal Breeding and Migrations of the Desert Locust (*Schistocerca gregaria* Forskal.) in Eastern Africa, XXIV, 1947, p. 117.

WORTHINGTON, E. B.: A Development Plan for Uganda (Ed.), XXIV, 1947, p. 206.

HUTCHINSON, J. B., SILOW, R. A., and STEPHENS, S. G.: The Evolution of *Gossypium* and the Differentiation of the Cultivated Cottons (G. D. H. Bell), XXIV, 1947, p. 276.

BRIXHE, A.: Les Lotissements Agricoles du Nord-Sankuru (Ed.), XXV, 1948, p. 45.

FISHER, R. A.: The Design of Experiments (J. B. H.), XXV, 1948, p. 47.

Colonial Research 1946-47 (Cmd. 7151, 1947), XXV, 1948, p. 208.

Colonial Primary Products Committee: Interim Report, January, 1948. (Col. No. 217, 1948), XXV, 1948, p. 208.

Recommendations for the Organization of Colonial Research in Agriculture, Animal Health, and Forestry (Col. No. 219, 1948), XXV, 1948, p. 210.

PLANT PROTECTION LTD.: Agrocide Range of Insecticides based on Gammexane, XXV, 1948, p. 212.

Colonial Development: Fifth Report from the Select Committee on Estimates 1947-48, XXV, 1948, p. 281.

Report of West African Oilseeds Mission (Col. No. 224, 1948), XXV, 1948, p. 282.

HABARI YA NZIGE*

BY

R. C. RAINEY

(Dr. Rainey has recently returned from a period of secondment to the Anti-Locust Research Centre for field research on the Desert Locust in the Somalilands, and on the Red Locust in Tanganyika.)

A MONTH or two ago a brief report of a forthcoming convention formally establishing an International Red Locust Control Service insinuated itself into the news among the more traditional details of international bickerings. The convention follows some years of informal co-operation between the signatory nations—the United Kingdom (on behalf of Kenya, Uganda, Tanganyika, Northern Rhodesia, Nyasaland, Bechuanaland, Swaziland and Basutoland), Belgium (for the Congo and Ruanda-Urundi), the Union of South Africa, and Southern Rhodesia. It represents another step towards the ultimate objective of not merely controlling locusts but of preventing locust outbreaks altogether—an objective which it first became possible to envisage less than 20 years ago.

Until this time the origin of locust plagues had remained as much a mystery as when the Desert Locust came with an east wind to afflict Pharaoh, or when 800,000 people died in Cyrenaica in 125 B.C. from famine resulting from a similar invasion. In the early 1920's, however, independent and almost simultaneous observations on two different species of locust, on the Caspian steppes and in South Africa, supplied the answer. Particular types of grasshopper, sufficiently different from the locusts in shape and colour to have been regarded as separate species, and usually leading solitary, unobtrusive and harmless lives, were liable, when crowded together in a particular manner during the immature wingless " hopper " stage, to develop the darker colour and communal marching habits of locust hoppers, and finally to produce strongly flying gregarious adults which were, in fact, swarming locusts.

Furthermore, this process of gregarization—the mobilization of the solitary grasshoppers to produce the locust swarms—was found to occur in nature only under the environmental conditions peculiar to certain " outbreak centres," of very limited extent by comparison with the vast areas invaded by the swarms. The prevention of outbreaks, by the careful supervision of the outbreak centres in order to

* News of locusts (Swahili).

detect and deal with the first signs of swarming, has been a long-term objective actively pursued by a special committee set up by the British Government in 1929 to consider not only defensive measures against locusts but also the possibility of a radical solution of the problem by attacking the mechanism of swarming. This committee functions through the Anti-Locust Research Centre, established by the Colonial Office and unpretentiously accommodated in one of the remoter corners of the Natural History Museum at South Kensington. The Centre has been "recognized since 1930 as an international co-ordinating, advisory, and forecasting centre, and has been the inspiration behind all recent developments."

Thus for example in the early 30's, as the great Red Locust outbreak gathered momentum in eastern and southern Africa, a careful analysis of the earliest swarm reports directed attention to south-western Tanganyika and the adjacent parts of Northern Rhodesia. The outbreak continued, reaching Natal by 1933 and Uganda by 1934, and at Barberton in December, 1939, we watched promising young stands of 2-ft. maize plants reduced to six-inch skewers in an hour or two by a passing swarmlet of the handsome insects with the carmine hindwings.

Meanwhile, however, field work had demonstrated that the outbreak centres for this species were in fact situated in the seasonal swamps of the Rukwa rift valley in Tanganyika and the Mweru-Wantipa on the Northern Rhodesia-Congo border. An Anglo-Belgian control service, set up in 1941, began to tackle the very considerable difficulties presented by control operations in these areas. The annual campaigns against the hoppers had to be undertaken during the floods each year, with African porters as the sole means of transport, and in 1945, following large-scale breeding, it was not possible to prevent a number of swarms from escaping from the Rukwa. The second generation of the progeny of these swarms was reported in 1947 infesting the vast, uninhabited, tsetse-ridden Malagarasi swamp to the north, and, with further heavy breeding again in the Rukwa, constituted an immediate threat to the ground-nuts scheme and other development projects in this area, as well as a longer-term but very real menace to the agriculture of most of Africa south of the Equator.

British, South African and Belgian resources were pooled to meet the emergency. An extensive programme of road-building and base-camp instruction in the Malagarasi during the dry season made possible an arduous three-month campaign, since which no further swarms have been reported from this area. In the Rukwa, intensified routine control operations were supplemented by a dramatically successful experimental air-spray campaign, and the locust population was reduced to a level which not only disposed of the threatened outbreak,

but was even insufficient for the further air-spray experiments which had been planned.

The more destructive Tropical Migratory Locust (popularly and appropriately known as the " hairy-chested locust "), poured without warning into Northern Nigeria in 1929 and spread steadily, generation by generation, to cover eventually ten million square miles of Africa. Despite costly campaigns in British and French West Africa, Equatorial Africa, the Sudan, Eritrea, British East Africa, the Belgian Congo and the Rhodesias, improvised to attack each generation of hoppers, the outbreak lasted until 1937 and crop losses were considerable. However, as with the Red Locust, an analysis of the earliest swarm records, followed by field work in another of the less attractive parts of Africa, showed that the outbreak centres of this species occupy two quite limited areas of a few thousand square miles among the swamps of the River Niger in the French Sudan. Plans for the establishment of an international organization to supervise this zone were interrupted by the war, but the French, acting alone, founded a preventive service which has kept these areas under observation since 1939. Arrangements are now being made for British and Belgian co-operation in the maintenance of this service.

The Desert Locust, last of the trio of major African locusts, flared up into a new outbreak in 1940, and menacing the vital food-producing areas of India, the Middle East and East Africa, threatened to add the last straw to the overburdened Allied supply lines of 1942-43. The reporting and forecasting service of the Anti-Locust Research Centre enabled every country concerned to receive timely warning of the development outbreak, and a directive giving locust control a priority second only to military operations was followed by co-ordinated control measures on an unprecedented scale over the whole area affected. Not only were intensive campaigns carried out in such territories as India, the Anglo-Egyptian Sudan and British East Africa, where efficient local entomological organizations could be relied upon to organize control measures in their own areas in accordance with the general strategic plan, but military resources made it possible also to attack the locusts in key breeding areas such as Arabia, southern Iran and the Somalilands, without waiting for the swarms to penetrate to the vital agricultural areas. Anti-locust units made their way into some of the wildest and most inaccessible parts of Arabia (earning incidentally at least one R.G.S. Founder's Medal), and by 1944 motorized baiting parties were penetrating practically the entire breeding area. The British Middle East Anti-Locust Unit, administered by the Middle East Supply Centre, was assisted in Arabia by the Saudi Arabian Government and worked in co-operation with Egyptian and Indian parties; in Iran the British unit worked alongside Russian,

Indian and Iranian missions. Regional anti-locust headquarters such as Teheran, Jedda, Baghdad, Damascus, Asmara and Nairobi organized the campaigns within their own areas; the scale of the operations is indicated by some of the seasonal campaigns in which as many as 500 vehicles and 5,000 men were used by the East African Anti-Locust Directorate alone.

The success which attended these unprecedented efforts is illustrated by the fact that this was the first locust invasion of this region which did not result in serious crop losses. The fertile lower Nile valley, usually a primary target, was not reached by swarms; damage in Syria, Palestine and Iraq was on a negligible scale compared with previous invasions; and Kenya, the granary of East Africa, where the previous outbreak had necessitated large-scale famine relief measures, managed to check the invasion on the threshold of the agricultural areas, and sustained no losses of any consequence.

But the cost of these five years' operations against the Desert Locust was heavy—something like £5,000,000 to the British Government alone; in the past similar outbreaks have recurred every 10-15 years; and the cost of undertaking similar campaigns in the future would be still greater, because agricultural developments in Africa will have increased the average of crops threatened. The long-range objective of outbreak prevention, of which the importance is thus so obvious, was not lost sight of during these direct control operations. The Desert Locust is the most widely distributed of all locusts, ranging from Senegal to central India and from Turkey and the southern U.S.S.R. to Tanganyika; and outbreaks of this species may in fact develop from several widely separated areas. Outbreak centres were demonstrated on the coast of the Anglo-Egyptian Sudan during the 30's; later work incriminated the Baluchistan coast; and observations during the recent outbreak have brought areas on the shores of the Gulf of Aden and the Red Sea under suspicion. Furthermore, Indian work has shown that swarm formation may be a relatively gradual process, involving the migration of solitary and intermediate forms of this species between zones of summer and winter rainfall. The prevention of Desert Locust outbreaks thus appears to be an inherently more complex problem than that of the other two species; and the Desert Locust moreover inhabits a region where international co-operation is particularly prone to be complicated by non-scientific considerations. However, while proposals and counter-proposals for the establishment of an international preventive service continue to meander gently through the normal diplomatic channels, plans have been drawn up for a Desert Locust Survey organization based in Nairobi, and utilizing the experience of the Middle East Anti-Locust Unit and the East African Anti-Locust Directorate, to investigate and supervise

known and suspected centres round the Red Sea and the Gulf of Aden.

In the course of the recent extensive operations against locusts, substantial advances have also been made in the technique of direct control. The traditional methods of beating and burning the hoppers die hard, and modern variants such as trenching, supplemented by metal barriers, and the use of flame-throwers, persist for example in parts of South America. Considerations of efficiency, mobility, cost and economy of labour, however, have made poison-baiting the basis of all modern campaigns. Arsenical poisons have been very widely used, and, if the bait is properly distributed, may be employed without detriment to stock. The introduction of benzene hexachloride as a bait poison in 1944 marked a further milestone in the development of locust control. Its effectiveness is illustrated by the fact that, in skilled hands and under good conditions, 5 lb. of a standard bait containing 0·5 per cent. benzene hexachloride, or about 0·065 per cent. of the toxic γ-isomer gammexane, can destroy an acre of hoppers—meaning that something like five million insects are killed by less than 2 grams of the insecticide. As it is moreover non-toxic in normal dosages to higher animals, its introduction has eliminated the difficulties and suspicion inseparable from the use of arsenicals in primitive countries inhabited by pastoral tribes like the Somalis, and is enabling poison-baiting to replace more antiquated control methods in the cattle-raising countries of South America.

While experiments on the application of insecticides by aircraft were first undertaken a quarter of a century ago, a locust swarm presents a peculiarly elusive target on which both demarcation and the assessment of results are liable to be particularly difficult. The earlier aircraft trials against locusts in various countries, therefore, tended to be largely a story of premature publicity and inconclusive results. Systematic experiments were accordingly initiated by the Anti-Locust Research Centre on behalf of the Colonial Office, and carried out in co-operation with the Royal Air Force, the South African Air Force, and the Ministry of Supply. The first experiments of the series were carried out in 1944 against the Desert Locust in the Kenya Highlands, using apparatus and methods derived from the Russians, who had been co-operating in locust control operations in Persia. These Kenya trials indicated the lines along which further research was necessary—the insecticide and its distribution, locust behaviour, and field organization and methods. The necessary fundamental investigations of the principle of insecticide application were carried out at the Chemical Defence Experimental Station at Porton, Wiltshire (a picturesque extension of the original functions of this Station in connection with chemical warfare), and put into practice in Kenya in 1945. The value

of the methods developed at Porton was substantially confirmed, but the behaviour of the locusts still involved difficulties in swarm demarcation and in the assessment of mortality. Further improvements were made in the apparatus and the insecticide during the following year, and utilized in 1947 in the experimental campaign carried out jointly by the Governments of South Africa and the United Kingdom for the International Red Locust Control Service in the Rukwa Valley, where the terrain was exceptionally favourable for attacking the roosting locusts. The operations were further facilitated by the unusually sluggish behaviour of the locusts, and, using the new 20 per cent. dinitro-ortho-cresol in a special mixture of aromatic extracts of petroleum, the results were spectacularly successful. "In one operation a mortality of 98 per cent. was obtained at a dosage of ½ gallon to the acre. In another, nearly two square miles were 95 per cent. cleared of locusts at a dosage of 0·7 gallons per acre; six aircraft . . . covered the ground at a rate of nearly 12 acres per minute from start to finish. . . ." It was afterwards stated by the Director of the International Red Locust Control Service that a substantial contribution had been made towards checking the threatened outbreak from this area. Under suitable conditions of terrain, locust behaviour and weather, the specially equipped spraying aircraft is thus a most useful supplementary locust control weapon, but it is emphasized that it is in no sense a substitute for the less spectacular but vital ground operations. Incidentally, benzene hexachloride, which is so effective as a bait poison, gave inadequate results during these experiments as an aircraft spray; and the earlier trials at Porton had shown that D.D.T. is also relatively ineffective for this purpose, despite its usefulness in other respects.

An interesting by-product of the large-scale locust control operations in recent years has been the dispersal of a little of the mysticism usually associated with locust migration. One of the most striking features of many migratory swarms is the apparently steadfast maintenance of a cross-wind course, the locusts giving an almost irresistible impression of purpose and independence of environmental factors. Evidence is now accumulating to suggest that this impression is more than a little misleading, and in particular to demonstrate the importance of the wind in large-scale swarm movements. Thus recent determinations of the flying speed of the Desert Locust in the field have given values of little more than 10 m.p.h., which at once sets a very modest upper limit to the wind strength against which swarm movement is physically possible. Again, the detailed analysis of one particularly well-documented long-distance swarm movement, from South-West Morocco to Portugal in October, 1945, showed that the locusts concerned could not have maintained a steady course differing by more

than 10° from directly down-wind during the 600-mile sea crossing; further, it was not even necessary to assume that a constant orientation was maintained at all, since the observed distribution of locusts in Portugal could also have resulted from either continuous circling or merely frequent random changes of course. Again, a summary of the thousands of records of Desert Locust swarms received from East Africa has demonstrated major seasonal trends of migration which, with some exceptions, correspond in direction with the prevailing winds, and change with them; and some at least of the apparent exceptions have also been found to represent down-wind displacements.

In addition to these indications of the effects of horizontal winds, vertical air movements, particularly the convection currents over heated ground which are sought after by sailplane pilots and are all too familiar to many aircraft passengers, also appear to be of considerable importance to flying locusts. Thus locust swarms fly sometimes at low altitudes in sheet or pancake formations, against which air-spray operations are practicable, while at other times they fly in great towering formations, thousands of feet in vertical extent, against which such operations are much less promising. There is reason to believe that this difference in behaviour is attributable to variations in convective activity, and up-currents exceeding 700 feet per minute were recently demonstrated by pilot balloon in association with the latter type of swarm behaviour in Somalia. There is other evidence that locust flight at high altitudes, which is also likely to be important in rapid long-distance swarm movements, is associated with vigorous convective currents. Thus a B.O.A.C. Lodestar which reported numerous locusts at 7,000 feet near Berbera in August, 1946, recorded at the same time an air temperature which, in conjunction with the corresponding surface data, indicated unimpeded convective currents over the coastal plain to at least the height of the locusts.

The recent history of these locust outbreaks thus records, not only increasingly efficient control measures on a continental scale, but also and at the same time intensive long-range research which in a brief twenty years has gone a long way towards making it possible to eliminate future outbreaks altogether. An interesting comparison is afforded by the rather similar problem of grasshoppers in the United States. It was formerly believed that the general agricultural development of the country would automatically eliminate these pests, but the rapid expansion of unplanned agriculture in North America has, in fact, created exceptionally favourable conditions for the various insect pests and for grasshoppers in particular—incidentally providing a warning of the potential danger from grasshoppers to mechanical agriculture in Uganda. The value of the crops destroyed by grass-

hoppers in the U.S.A. in recent years is officially stated to average more than 40 million dollars per annum. Nearly 3 million dollars are spent annually on direct control measures, and thanks to the work of the Division of Grasshopper Control, and to the close co-operation of Federal and State agencies and the farmers, it is estimated that on the average each dollar spent on grasshopper control saves crops to the value of $35. Research on grasshoppers, however, both in the United States and Canada, is dominated by the need to produce immediate practical results, on which its year-to-year financing depends, and is accordingly practically confined to empirical tests of new insecticides and to routine grasshopper survey records for estimating the demand for control materials for the next campaign. Despite the representations of American and Canadian entomologists, it is apparently very difficult to convince the administrations concerned of the need for any expenditure that does not provide immediate return—even for the analysis of the existing survey data. Accordingly there appears at present to be no prospect of a permanent solution to the North American grasshopper problem comparable with the sober hopes which have grown from twenty eventful years of long-range work on the locusts of the Old World.

Habari mzuri tu—lakini . . . *

* Only good news—but . . .

Received September, 1948.

TWENTY YEARS IN THE COTTON RESEARCH BOARD AT GIZA

BY

W. LAWRENCE BALLS, C.M.G., C.B.E., Sc.D., F.R.S., F.T.I.(HON.)

THE "C.R.B." was a delightful anomaly. Rather affectionately regarded by the staff of the technical sections of Egypt's Ministry of Agriculture, it had an international reputation owed to its designation, which seemed to inspire more confidence than ordinary office titles, but in reality there had been no such body for many years.

In a previous article about "Giza" in this Review (October, 1935), I described the C.R.B. as a vestigial survival of the original Board, attending to such liaison services common to the different Sections as publication, carpentry and photography. As the Sections grew larger all but two moved elsewhere, and the offices were cut until when I resigned in 1947 there were only two clerks left.

The Board was originally constituted to advise the new staff who were brought to Egypt after 1918, and lost its *raison d'être* as these acquired local knowledge. When I returned to Egypt in 1927 the various technical Sections were largely dissociated, and ignorant of one anothers' activities, so a Laboratory Research Committee was formed which met monthly and considered a monthly report previously circulated. These reports dealt with all agricultural investigations, but cotton necessarily predominated; thus, in effect, the C.R.B. was reconstituted. The bound volume for 1939 runs to 800 pages, and several hundred copies were circulated monthly in English and Arabic, but we declined from this zenith until, by the end of the war, the system was only kept in being by half a dozen keen workers.

The reports were cross-indexed for all references to cotton by my wife in 1946, and this note is a summary of that index, which may later be expanded into book-form. A large part of the index deals with results obtained in the Spinning-test Mill by the late H. A. Hancock, but I hope to publish these separately and posthumously as a book entitled "Spinning Tests on Cotton Crops," edited by myself; they will not, therefore, be included here. The present condensation, though rather indigestible, should have some use by illustrating the range of topics implicated by investigations on cotton, from an outlook which was primarily that of the farmer, but brought in technological and mercantile considerations as well.

To keep the text within the limits of space available we will first

deal with subjects which have more than thirty entries in the index, putting the approximate number of entries in brackets. Afterwards we can make a selection of the minor entries.

For Aphis (40), Pink Boll-worm (100) and Cotton-worm (60), on which there are several publications, we find entries on predators and parasites, temperature relations, life cycles, insecticides, varietal reactions, and the effects of various agricultural procedures; mapping of distribution both local and country-wide, costs of control measures, studies of dispersal from sources of infection whether local or through migration, and data from mass-observation. These last, in the case of the pink boll-worm, are available through seed-control measures to cover twenty years.

The remarkable effect on yield from Dibble-sowing (40) has been published in a Giza bulletin, and is related to Germination (30). Irrigation (40) is discussed in relation to its frequency, relation to meteorology and the amount and composition of the water used. A series of bulletins has been, and is still being, published on Manuring (60). Observations made in the glass-fronted Root-observation Pits (70) are related to the manurial work on soil deterioration and profile changes, besides dealing with morphology, water-table effects, and root-asphyxiation. Seed (60) entries cover control measures, storage effects, weight fluctuations and germination in field or laboratory conditions. In addition to chemistry, the Soil (60) references deal with moisture content, stratometry, profiles and variation in general. Descriptions of Varieties (70) are necessarily abundant, with determination of relative values, specific reactions to pests, and so forth. Testing of resistance to Fusarium Wilt (70) includes studies of its microscopy and of segregation followed up in certain strains. The history of Yield (30) in Egypt, methods and results of its measurement, and its variation with circumstances concludes the alphabetical order of the big groups of entries.

Except for dibble-sowing and the root-pits these entries are such as one would expect to find in the index of work done by any cotton experiment station, though the small size and long history of Egypt give exceptional interest to mass-observation data on the crop. The excerpts from minor entries which follow are possibly more suggestive, but in order to keep a sense of balance we may here note that the largest number of all references is for those dealing with spinning, or the quality of cotton, which I have grouped for the purpose of Hancock's book under the following heads: The Mill Itself, Modifications of Spinning-Mill Technique Devised for Speedy Testing, Measurements for Defining and Predicting Strength, Some Accidents which Happen to Cotton, the Significance of Grade, New and Old Cottons, Environmental Effects on the Growing Crop, and The Inheritance of Strength.

It will be understood that not all the following entries represent investigations carried to a successful conclusion. The Laboratory Research Committee Reports were progress reports, in which notions and accidental observations could be recorded as well as complete experimental results. Entries which cross-index to the major topics already listed are mostly omitted.

A. Aeration of soil in "basin cultivation," photographing chequer-plots from the air inexpensively by kites, a series of aerial photographs of the Giza farm throughout one season, albino seedlings, angular leaf-spot, Asiatic cottons, the *Aspergillus* test for phosphates.

B. Coarse and fine balances adapted to automatic weighing, moisture-content changes in country and export bales (published), relation of water-table levels and growth to barometric changes, activity of bees in natural crossing (published), berseem and its harbourage of cotton worm, composition of Blue Nile flood water in comparison with the major water supply from the White Nile, hardness of the green boll surface, boll weight and chemical composition, reclamation of small panned areas by means of bore-holes, description of a bore-hole one hundred metres deep, boron content of separate plant organs, branching, bud-shedding cytology, infestation by bugs.

C. Building of bee-proof cages of stainless steel gauze covering two acres, capacitance hygrometry on bales and in soil, chlorosis, secular change of climate over the eastern Mediterranean, effects of colchicine, results from cold storage of seed over a period of eight years, colour inheritance, the attractiveness of coloured dusts to aphis, electrical condensers, contour diagrams of plant-development curves showing yield-alterations during a decade on the same plot, contracts for seed-propagation, the lesser cotton-worm, cracks in soil.

D. DDT trials, fluctuations in the cotton from daily pickings (published), initiation of a system for dating seed according to the year of its origin from a nucleus stock, defoliation effects, dielectric constants of cotton longitudinally and transversely (published), double embryos, changes in the quantity and composition of drainage water, direct effects of insecticide dusts on the plant.

E. *Earias* or spiny boll-worm, genetics of Enan's Brown cotton, graphic presentation of the combination of errors.

F. Fellaheen customary practices, changes in the date of first-flower appearance since 1913, flood and water-table movements (published), flowering curves, forecasting the crop by observation plots distributed through the Delta, fossilised soil-structures, frost damage, action of fungi on cottonseed cake, fuzz inheritance.

G. Gammexane trials, ginning out-turn in various aspects, effects of greenhouse cultivation when raising two generations yearly.

H. Effect of a hail-storm, hand spinning and hand ginning data, haploid plant, heat treatment of seed, heterosis, ratio of yield between Hindi and Egyptian in terms of number of seeds produced, history of crop-yields on the Giza farm, number of plants per hole, shape of hole, some descriptions of hybrids.

I. Indol-acetic acid treatment of seed, internode length in relation to root-development.

L. Leafiness of lint related to irrigation intervals, leaf-curl found in Egypt on hollyhocks but not on cotton, alteration in leaves from maltreatment, locality effects, visitation of locusts.

M. Magnesium in soil, mole-crickets, marginal effects in plots, timing of maturation of boll, boll-maturity relationships, meteorology in various aspects, micro-climate, mites, moisture contents of soil.

N. Natural crossing in space and time (published), natural selection by wilt attack and in mixed sowings, local production of nicotine, Nile flood records, changes in the composition of Nile water during its passage along canals.

O. Occurrence of two pests in desert oases, oil-content of seed as affected by variety and by locality.

P. Effects produced by pans in soil, perennial irrigation compared with old basin system, photo-cell application, peculiarities of individual plots, propagation of renewal seed, proteins in cake, proximity effects between rows of different varieties, pruning of roots.

R. Ratoon plants in relation to pests and yield (published), yield and root-development, reddening of leaves and of seeds, re-sowing, reversing gear for driving apparatus (published), effects of ridging, ringing of stems, records of river temperatures, Giza as the Egyptian equivalent of Rothamsted.

S. Seasonal effect, seedling development, sharaki (fallow) effects, shedding, the secular change in sowing-date, modern optimum spacings compared with pre-bollworm optima, stainer bug, stand of plants as affecting yield, cotton-stick problems, plot mapping with the stratometer, sub-soil water changes and effects with various compositions, sunshine effect shown in root-growth, the position of sympodia.

T. Tachinid flies, Tanguis cotton, tap-water temperature indicating soil temperature, temperature effects, thinning methods, giant toads as predators, topping of the plant.

U. Upland cottons.

V. Variance, vernalization, voltage regulation.

W. Weather effects, improvement of wet-bulb thermometer (published), white cotton market demand, winter-grown crops.

The initials appended to the various contributions are about forty in number. Those which occur most often—the spinning contributions being excluded—belong to A. Bedevian, C. H. Brown, D. S. Gracie, F. Khalil, G. Abulela, I. Bishara, J. Templeton, L. B. Suliman, M. A. Kilani, M. A. Zaghloul, M. Fayek, M. Gohar, M. Rizk, R. Aladjem, T. Fahmy, W. L. Balls and W. T. H. Williamson.

Looking back over the twenty years, and the resulting two thousand entries in the Index, one cannot but feel regret that more was not done with the many results obtained. Lack of concentrated and prolonged attention was due in part to the over-weighting of the technical sections with accessory staff, which in turn involved distracting administrative responsibilities for the senior scientific officials, conducted within the limitations of rigid government regulations. Promotion for good service was hard to obtain; the scientific worker devoted to his subject was too fully occupied to have the time for acquiring the necessary influence. Publication of results was very uneven, and the war made matters hopeless; brevity is usually a sure indication of clear thinking and scientific value, but the tradition of the East puts a premium on prolixity, and the emphasis is on words rather than on work. The tri-lingual status of the Egyptian is a further handicap for accuracy; most of them think in colloquial Egyptian Arabic, and translate into polite Arabic or their foreign language as the need may be. The acquisition of status and power over fellow-officials is too often valued far above scientific reputation and experimental ability, and in this respect the Laboratory Research Committee reports give internal evidence concerning the value of a few non-Egyptian colleagues, who provide a stiffening frame of professional scientists as distinct from professional officials.

Nevertheless, much was accomplished. The strength of the best Egyptian cottons was improved steadily from 26 to 33 and more, which, since Strength is Value, means a big increase in selling price on normal markets. Concurrently, the yield was raised until a variety of strength 28 now gives the same crop per acre as the otherwise heaviest yielder, which had a strength of only 18. The devastations of the pink boll-worm, dating back to 1911, have been cut down until it is a minor pest, and the new insecticides hold promise of similar mitigation for cotton worm, instead of having to depend on administrative efficiency. The grade of the crop has risen without a check from the old Fully Good Fair level till it is now well above Good. Even so far back as 1934 it was reckoned that the extra profit obtained by then

from the introduction of Giza Seven had repaid every piastre expended on botanical research for Egyptian agriculture since it was initiated by the old Khedivial Agricultural Society in 1904. Today the profits to Egypt from the work of the C.R.B. amount to some tens of millions of extra national income for each and every year of cotton-growing.

Received May, 1948.

WHIT-MONDAY IN LYONS

BY

J. B. HUTCHINSON

There are many worse places than Lyons to spend Whit-Monday. We had left Malta at 6 a.m., in an Airwork Viking, and we were due to land at 10.40 to refuel. It was my wife who first suggested that we might stay longer than we expected. Air travel is the only subject on which we differ seriously. I contend that it is quick, but boring. She says it is only quick if it is all right, and since it probably won't be all right, it can't be said to be boring. For once she was right. As we completed a circuit of the airport, she said, "They can't put the wheels down." As we did a second circuit, I said, "Probably another aircraft coming in to land." The remark failed to carry conviction, as the Engineer went hurriedly to the rear of the plane and returned with tools, and shortly afterwards made another quick trip for a can of water.

A little later the Captain came out and told us they had trouble with the undercarriage, and could not get one wheel down. They hoped to persuade it to work, but if they failed, we should circle for some time to consume petrol, and then do a belly landing. It soon became evident that the wheel was not going to function, and the Engineer came out and gave us our emergency instructions—adjustment of seat belts, method of knocking out windows for emergency exits, and so on. After that we had an hour or so to kill with what courage and patience we could muster. I couldn't help wishing—if it had to happen—that this had been one of my trips alone. My wife, two small children, and my father-in-law constituted a responsibility I would rather have left to the insurance company. We told the children we might open the emergency windows and drop them out when we landed. There were tears, not unnaturally, and presently between sobs, Helga (aged 8½) said, "Daddy, couldn't you wait until the plane stops before you drop me out?" Having given an assurance on that point, I tried to admire Lyons from the air. We swung left-handed round the airport, where we could see vehicles of various shapes mustering on the perimeter road like horses at a starting gate, out by a factory chimney, over the cemetery, across the river, and round again. Several people commented afterwards on the tendency of the mind to focus on the cemetery.

It was a relief when the Engineer came out again and said, "We're

going to try it." He left the pilot's cabin door open, and took up his station at the main exit with an axe. The hostess took a baby of a few months, to leave the mother free for a two-year-old, and strapped herself in by the exit. As we swung low into the straight we felt our safety belts and settled down to watch. . . . Low over the housetops . . . low over the tree tops . . . lower over the fences . . . still lower and slower over the grass . . . the Captain cut the engines and the propellers stopped . . . we touched down and skidded, straight and level. The passengers facing forward leapt into their seat belts like horses to the collar, and settled back again. We heard the second pilot's voice, a mixture of relief and admiration, "Good show! Marvellous!" and we knew we'd made it. The plane skidded to a standstill, dead straight and dead level. The Engineer dropped his axe and opened the door. We threw off our safety belts and stood up. The passengers in the rear compartment were getting out. The crew came out of their cabin, and we in the forward compartment, forgetting the first principles of air safety, crowded round the Captain, smote him on the back, and pump-handled his hand. He, with the same coolness that had brought us safely down, remarked that it might be a good idea to get out, just in case a fire was brewing.

We had landed in long grass a few yards from the runway. When I had helped my father-in-law down and had time to look for the rest of the family, our small boy was picking wild flowers. Larks were singing, and the sun was shining, and Lyons airfield was looking very like a Whitsun picnic. Everyone who could find any excuse to be there had come along. The fire engine was ready for action long before I got out. Sitting on the footboard of the crash truck, two young men were quietly peeling off asbestos boiler suits. A little further away was an ambulance. A coach driver, finding his was the only vehicle really needed, was bringing his coach a bit nearer. And in a very nearly continuous ring round the plane lay the bicycles of those who could not pile on the lorries. Frenchmen, beaming with pleasure and relief, shook us warmly by the hand, and apologized for their limited English, and we beamed back and murmured a few words in Arabic! As soon as it was decided the fire risk was over, we all fell over each other in our anxiety to help hand out and sort the coats and hats and handbags we had with us.

There must be thousands of men to whom such a landing was for years one of the recognized hazards of life. Nevertheless, twenty-three passengers, of both sexes and all ages from 81 to a few months, constitute a very considerable addition to a Captain's responsibilities. I suppose the plane weighed about 15 tons when it touched down, and they said we did it at 75 miles an hour. To set that down without a bruise or a scratch to anyone, or even any very serious damage to

the plane, seems to me a pretty good show. One man had forty eggs in his over-night bag, and not one of them was broken.

Lyons airport building has observation verandahs on the first and second floors, and these were lined with spectators waiting to give us a welcome. We drove up in the coach, and turned the Captain out first to take his well-earned applause. The rest was just a matter of waiting. They gave us a good lunch, and soon after we were told that Airwork would have a relief plane at Lyons for us by 5.30 p.m. The crew went back to the plane, and crawled into the somewhat squashed belly compartments and extracted our baggage. One or two suit-cases were broken open to get them out, but the damage was negligible. Airwork were as good as their word, and the relief Viking touched down at 5.30. It took off again at 6.30, and we had a wonderful view of France in the evening light. We landed at Blackbushe about 9 p.m., about 7 hours late, a much smaller delay than might have been caused by bad weather.

Someone, seeing the relief plane was a twin to the one lying on the airfield, asked if we were not afraid to go on. I don't think anyone was. The children were anxious to be off again, and none of the rest of us seemed to feel inclined to go by train instead. Unfortunately, I can't quite convince my wife that our Whit-Monday in Lyons was an object lesson in the safety of air travel, but to me it seems a matter for confidence to have experienced how a good air crew with a good aircraft can turn an emergency into a minor incident. Three accidents were reported on British Railways the day after we landed, and if you look into it, it costs you more to insure against rail risks than air risks. Air insurance from Khartoum to London works out at about 2s. per £1,000 per 1,000 miles, and rail insurance from London to Manchester at just over 2s. 6d. per £1,000 per 1,000 miles. I'm not sure that the comparison would be acceptable to an insurance actuary, but it seems about right to me.

Received May, 1948.

A METHOD OF DETERMINING HAIR WEIGHT OF COTTON

BY

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A RAPID method of sampling combed seeds of cotton in order to determine hair weights per unit length was described by V. G. Panse and V. B. Sahasrabudhe, 1943.

The procedure consisted of isolating a bunch of approximately 50 hairs from a randomly chosen portion of the seed, cutting to a length of 1 cm., spreading out the cut hairs on a glass slide and counting with a microscope fitted with a projection device. After counting, the cut portions are rolled back into a bunch for weighing. Samples of 50 hairs per seed from 22 to 32 seeds were found adequate for determining mean hair weights with a standard error of 4 per cent. The time taken for a single determination on 50 hairs was approximately 5½ minutes, and from the particulars given it may be concluded that a determination based on 20 seeds would require 70-80 minutes if the separate bundles of cut and counted hairs were combined and weighed as one.

In discussing the problem the authors suggested that further work was required to evolve a still more rapid method.

This note describes a method by which results not inferior in accuracy were obtained in approximately one quarter of the time—viz., a determination based on 40-50 hairs per seed from 20 seeds was made in 20 minutes. More extensive trials are needed to determine the average accuracy, but in one experiment the standard error was only 2·7 per cent. and in a second 4·4 per cent. for means of 20 seeds.

It should be noted that the accuracy is to a large extent dependent on the seed-to-seed variation displayed by the material. In the two tests referred to the material was respectively composite samples from a replicated variety test and small bulks from breeding plots.

The rapidity of the method is such as to allow of a considerable increase in the number of seeds per sample should the material demand it.

Outline of Method

The essential feature of the method is the detaching of a small tuft from the combed seed in such a way that the constituent hairs come away spaced out sufficiently thinly to permit of counting without any teasing out. The hairs are placed across a specially designed holder and counted *before cutting*. The holder is illustrated in Plate I. It consists

of two velvet-covered bars separated by a gap over which the hairs are stretched. The placing of the hairs and their detachment from the seed is performed in a single drawing motion applied to the seed while holding the tips of the hairs on the velvet with a finger tip. With a little practice a tuft of the required size (40-50 hairs) can be laid out in this way without difficulty. No preliminary dissecting out of the tuft from the general bulk of the hairs on the combed seed is necessary. Hairs not held under the finger tip remain attached to the seed and are drawn away with it.

The velvet-covered bars are 3 inches long and accommodate tufts from 10 seeds. When filled the holder is placed on the stage of a microscope arranged to project an image of the hairs on a screen for counting.

After counting, the hairs are collected together into a loosely rolled bundle by running the two forefingers down the length of the holder. The hairs are carried along with the fingers in a part sliding, part rolling motion. To assist in this, two metal strips, inserted on edge in slots in the two bars, are pushed up from below. These partially lift the hairs from the velvet and act as " runners "—see Plate I (*b*). A portion of known length is then cut from the centre of the bundle for weighing.

Details of Technique

Sampling. The tuft of 40-50 hairs may be taken from any part of the seed, either at random or from some chosen constant point such as the centre of one wing of a seed combed butterfly fashion.

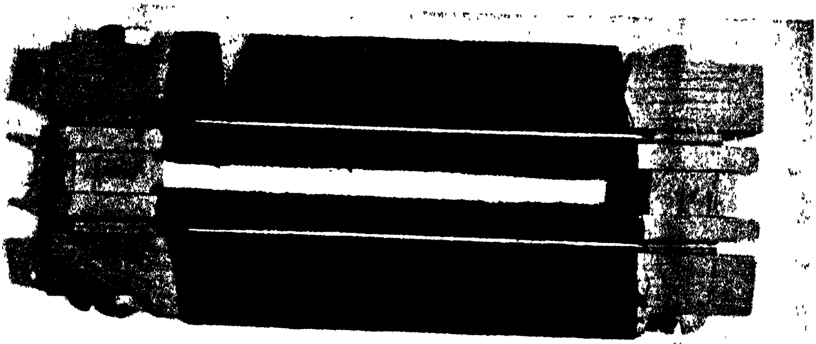
Number of Hairs per Tuft. Moderate variations in the number of hairs drawn from any one seed are disregarded provided they are spaced sufficiently thinly for easy counting. If too many are taken, some can be removed with forceps.

Loose Hairs. A few hairs not held under the finger tip may become detached from the seed and mingle with the required tuft. These may be smoothed away while holding down one end of the tuft with one finger. After smoothing off in this way the hairs remaining on the holder should all lie right across the gap, and over the slots carrying the metal runners, with their ends clinging to the velvet. The holders have been designed for cottons of 32-40 mm. combed length and have the metal runners 15 mm. apart, but the dimensions may be altered for cottons of shorter staple.

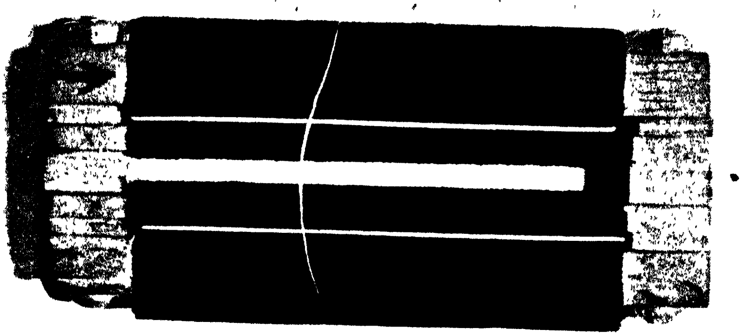
Counting. A magnification of $\times$ 50 has been found satisfactory. A mechanical stage with a traverse of 3 inches is needed and a hand tally-counter is desirable.

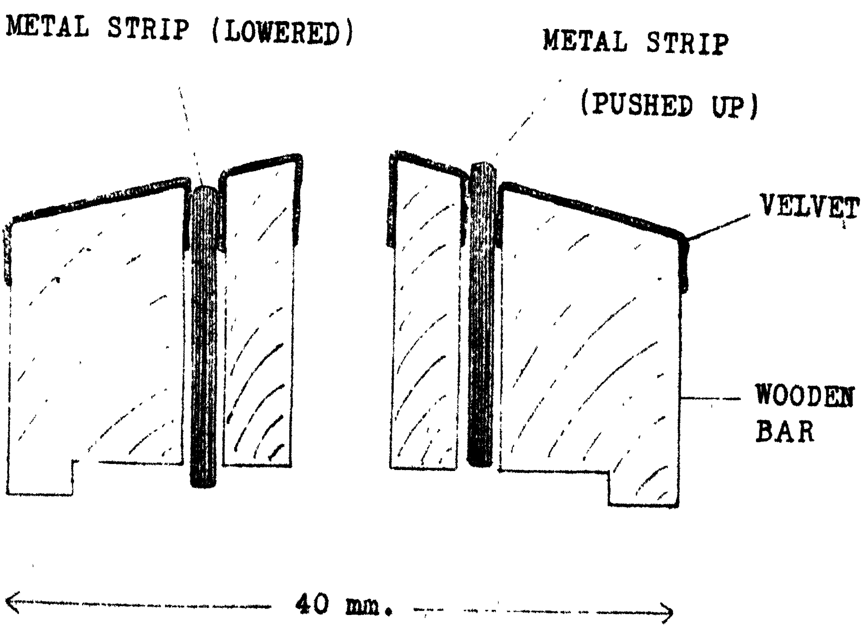
Bundling the Hairs. Care is taken to keep the hairs as nearly as possible parallel without twisting or excessive rolling and without touching the central portion between the runners. If a few hairs

a



b





(c) DIAGRAMMATIC CROSS SECTION

PLATE I.

are left behind on the velvet they are easily seen and their number subtracted from the total counted.

Cutting. The method used has been to stretch the bundle on a piece of smooth-surfaced dark-coloured card and place across it a strip of glass 15 mm. wide, making a cut against each of the two edges of the glass with a single razor blade. Suitable linoleum and a satisfactory double-bladed cutter were not available. The choice of 15 mm. length was to give a heavier bundle for weighing, but this would not be necessary with a more sensitive microbalance. A shorter length would ensure that the portion weighed was entirely untouched by the fingers.

Relative Humidity. The trials described were carried out over a period during which the relative humidity within the laboratory showed no large fluctuations. Such changes as were noted had only a small effect on the weight of a bundle of hairs and no allowance was made for them. As a routine, however, it would probably be desirable to adopt a simple form of adjustment of the observed weights to allow for departures from a standard humidity.

Examples of Results Obtained

Nine strains from a variety test, ginned lint of which had already been submitted to the Shirley Institute, were used in a trial of the method. Twenty random seeds of each strain, taken for combing before the spinning test samples were ginned, were divided into two random groups of 10 seeds to give two determinations per strain.

Analyses of variance of these duplicate determinations showed the variance due to strains to be significant at $P = \cdot 001$. The difference for significance between strain means at $P = \cdot 05$ was comparable in magnitude to that quoted by Underwood (1935) for hair weights determined from Baer diagram material.

The Shirley Institute determinations on ginned lint of these strains are given in Table I with the strains arranged and numbered in order of increasing hair weight. On the right of these are given the results obtained from the combed seeds with the strains retaining the same serial number but rearranged in order of the hair weights obtained by the new method. The brackets enclose strains not differing significantly from the lowest and the highest values in each case.

It will be seen that the order is not substantially different in the two cases. There are no really bad discrepancies and a selection of strains with the lower or higher hair weights would lead to almost the same result with either set of figures. The combed seeds have, however, given a mean value 4·6 per cent. lower than the ginned lint.

In a second set of material (combed seeds from small bulks taken from breeding plots), determinations on two sets of 10 seeds per strain,

TABLE I

Ginned Lint: Strain No.	Ginned Lint: H.W.	Combed Seeds: Strain No.	Combed Seeds: H.W.
1	152	1	144
2	153	2	146
3	154	4	151
4	174	3	156
5	175	6	160
6	177	5	166
7	181	8	166
8	184	9	182
9	185	7	194
Mean	170·6		162·7
Sig. Diff.	18·8 (11%)		13·9 (9%)

made in the same way, again gave very highly significant strain differences but with a rather higher standard error. The hair weights were in general considerably lower and the samples showed more variation from seed to seed.

For these samples also, figures obtained at the Shirley Institute are available for comparison, and the orders of merit and values obtained by the two methods may again be set out in parallel columns. Table II gives the data for these 20 samples.

TABLE II

Ginned Lint: Strain No.	Ginned Lint: H.W.	Combed Seeds: Strain No.	Combed Seeds: H.W.
1	116	3	121
2	121	1	128
3	125	4	128
4	126	14	132
5	128	9	133
6	133	7	137
7	135	2	138
8	136	17	139
9	137	5	144
10	137	10	145
11	138	6	146
12	139	11	154
13	140	15	154
14	145	18	158
15	149	12	159
16	152	16	160
17	154	19	164
18	155	20	166
19	155	8	169
20	157	13	176
Mean	138·9		147·6
Sig. Diff.	15·3 (11%)		18·9 (13%)

There are four bad discrepancies in this set—viz., strains 14, 17, 8 and 13—but there is nevertheless a fair measure of general agreement, having regard to the difference required for significance; a separation into groups of " high " and " low " hair weight would give reasonably similar results with the figures from either method.

In this body of material, the mean value for the combed seeds is 6·2 per cent. above that for the ginned lint.

Sampling from Different Points on the Seed. In the above two examples the hairs weighed were taken from the middle of one wing of the " butterfly." In earlier trials less attention was paid to the choice of position and greater variability was found in repeat determinations. The following figures, from a small trial comparing different points on the seed, indicate the importance of attending closely to this factor. Three strains were taken and hairs drawn from 3 positions on 20 seeds of each.

	*A*2106	*A*455	*A*346	*Average*
Hairs from " Apex " of Seed ..	192	192	166	183
,, ,, Middle of Side ..	157	166	130	151
,, ,, " Butt " ..	133	131	104	123
Average of 3 Positions ..	161	163	133	152

It will be seen that hairs from the " Apex " were 21 per cent. heavier and hairs from " Butt," 19 per cent. lighter than those taken from the middle of one side. Some immaturity determinations indicated that these differences were connected with variations in degree of maturity on different parts of the seed and agree with results obtained by other workers, notably Iyengar, 1944. The data indicate that confining sampling to the middle of one side may be expected to give a figure approximating to the average of the three separate positions.

Discussion

If the purpose is to make a rapid comparison of a large number of tentative selections in order to reject the less desirable, the exact reproduction of results obtainable by more meticulous methods is not necessary. The case is parallel to that of hair length, where cotton breeders make very considerable use of measurements on combed seeds, knowing that these do not reflect with exactitude the Shirley Institute " effective length." The degree of correspondence in the two cases seems indeed to be of much the same order.

Extensive trial is needed to determine the value of the method in breeding work, and modifications may prove advisable, but in its present form its rapidity alone makes it worthy of trial in cases where hair weight is an important consideration. In particular, it might well prove useful to a breeder faced with a demand for higher ginning percentage who wished to obtain this without increasing the hair weight. In selecting for lower hair weight it would of course be necessary to guard against a reduction due only to lower maturity, but the method could still be used to weed out the preliminary selections.

Of possible objections to the method the most obvious is that only the longer hairs are sampled. Data given by Clegg (1931) indicate that hair weight tends to be lower for the longer groups from the Baer diagram, although the differences are somewhat irregular. Lord

reports* that the effect depends largely on the purity of the cotton, and on the immaturity. In an immature cotton the longer hairs are usually of greater weight per cm. than the shorter. Turner (1929) and Iyengar (1941) also found a marked difference between the longest and shortest hairs in some strains.

It is not, however, essential to confine sampling to the longest hairs alone. A slight modification in sampling will enable hairs down to 28 mm. to be included on the holder as at present constructed, while the dimensions of the holder could be reduced if desired. The use of two holders, one for the longer hairs and a second for the shorter, taking a sample for each from each seed, would be feasible, but, of course, less rapid.

Similarly, and again at the expense of some increase in time, the sampling could be extended to comprise hairs from all parts of the seed. In this case, however, the number of hairs taken ought to bear some relationship to the density at different points of the seed-coat. Moore, 1941 (quoted by Iyengar, 1944), has shown that wide differences in hair density exist. Rather than an elaboration of this nature it would probably be better to sample the ginned lint instead of the combed seed. The technique can be adapted for use with tufts from ginned cotton while still retaining the principle of spreading and counting before cutting.

Acknowledgments

This work was commenced at the suggestion of F. R. Parnell and carried out as part of the programme of work of the Cotton Experiment Station at Barberton, under the direction of D. MacDonald. M. F. Rose and M. Oliveira Santos tried out a number of modifications of technique in 1944-45, but left the Station before the present rapid method was evolved.

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KEY TO PLATE I

(*a*) Holder with hairs laid out ready for counting. (Actual size.)

(*b*) Metal strips raised and hairs partially collected by sliding towards one end. (The operation has been left unfinished.)

(*c*) Cross section to show construction and dimensions. (Scale approx. 2½ times actual size.)

Received June, 1948.

* Unpublished comment by E. Lord, Shirley Institute.

PERCENTAGE OF SHORT HAIRS AS A CHARACTER OF IMPORTANCE IN BARBERTON COTTON SAMPLES

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It has long been a matter of concern to the cotton-breeding staff at Barberton that the yarn strength of cotton samples from this station bore so little apparent relation to the measured hair characters normally regarded as important guides to quality. Season after season the cotton and spinning test reports appeared to indicate that neither length nor fineness had as much bearing on spinning quality as is normally anticipated. Big differences in one or both of these two characters occurred, in some instances in association with marked differences in yarn strength in the opposite direction to that expected. In other cases gross differences in yarn strength were shown by samples not differing appreciably in effective length, mean hair weight, or maturity. In consequence, it appeared that under Barberton conditions the cotton breeder had no really sound basis on which to breed for improved spinning quality; selection for fineness and length was not sufficient.

A recent statistical analysis using the method of partial correlation has, however, revealed that the apparent lack of relationship has resulted from the mutually cancelling effect of two characters, hair weight and percentage of short hairs, varying simultaneously and acting in contrary directions on yarn strength. A total of 85 samples, from six separate experiments covering four seasons and including a wide range of types, has been studied. In four out of the six experiments there was a significant negative correlation between mean hair weight and percentage of short hairs. In three of these cases and also in the other two sets (in which the correlation between hair weight and short hairs did not reach significance) the calculation of partial coefficients, eliminating percentage of short hairs, brought out an underlying significant correlation between hair weight and yarn strength. In the sixth case also there was a significant partial correlation between "fineness" and yarn strength when standard hair weight was taken as the measure of fineness.

More surprisingly, in four out of the six sets, the percentage of short hairs showed a significant partial correlation with yarn strength after eliminating hair weight. In the other two cases significance at $P=0{\cdot}05$

was not attained, but the magnitude of the coefficient exceeded that necessary for $P = 0 \cdot 1$ and was of the expected (negative) sign.

It thus appears that in Barberton material the percentage of short hairs is of much greater importance than has previously been realized. On average, in the material studied, an increase of one unit in percentage of short hairs resulted in a drop of approximately one unit in Highest Standard Count. With the percentage of short hairs tending to increase with decreasing hair weight, this was more than sufficient to cancel out the improvement in yarn strength, which would otherwise have followed increasing fineness.

It is suggested that the upsetting effect of varying percentage of short hairs may be found to explain other instances of apparent lack of relationship between fineness and yarn strength. As regards Barberton cottons it is clear that greater attention must be paid to uniformity of length. A method of gauging the proportion of short hairs on the individual seed is now under trial.

The Shirley Institute are very kindly co-operating in these investigations, and samples containing varying proportions of short hairs are to be sent for small-scale spinning tests.

Received July, 1948.

THE TREE-COTTON IN YUNNAN

BY

K. S. CHENG

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ALTHOUGH China is an important cotton producer in the world, she produces only the medium-staple Uplands and the short-staple cottons of Asiatic type. The long-staple cottons consumed are imported from Egypt. The record was 100,000 quintals each year before the Japanese invasion. It is estimated that following the cessation of the civil war there will be a greater demand for cottons of finer quality. Yunnan is now the only province in China where cotton of the Sea Island type* is grown on an appreciable scale. It is hoped that with expansion of the acreage under this perennial tree-cotton (*Gossypium barbadense*), China will gradually decrease her import of high-quality cottons.

The earliest history of *Gossypium barbadense* in Yunnan is obscure. The tree-cotton had been grown in Kaiyuan under the care of Mr. Fu for some twenty years. In 1936, Dr. Feng discovered it in a trip to Kaiyuan and the prospect of establishing a long-staple cotton industry was first made known. It attracted so much attention that a committee was soon established for the expansion of its cultivation. Other perennial Sea Island types were also found in more than ten counties of Yunnan and a collection of them was made by the National Agricultural Research Board. At least six distinct varieties may be fairly easily distinguished and they are now used as stocks for breeding work. Among them, the Kaiyuan Free-seeded is the most prolific, with a staple length of $1\frac{3}{16}$ in. to $1\frac{1}{4}$ in., and it is the variety now recommended to the farmers. Another variety from Wenshan is of the best quality, has a very fine white fibre, about $1\frac{1}{2}$ in. in length, but the yield and lint percentage are both very low.

The acreage under tree-cotton has increased gradually but steadily since 1937. It is now estimated that nearly fifty thousand mow, or about eight thousand acres, of land are devoted to it. The produce of 1947 was valued at an amount much greater than the total agricultural budget of the National Government for the same year. Recently, spinning tests with the tree-cotton have been made at the Shirley Institute, and through the care of O.F.A.R. The comments

* As usually understood, the term Sea Island applies to forms of *G. barbadense* grown as annuals.—ED.

are good and the appearance of 70s yarn pretty fair. Only the scant yield now prevents it from holding a market of its own. The extension of its cultivation is therefore of the first importance, but this was handicapped by the low yield per acre and the fact that the tree requires two years to make the first good harvest. The latter problem has been partially solved by intercropping in the first years and by long-term loans to the farmers. The former is, however, a more complicated problem. The average annual yield per acre now is somewhat below 360 lb. of seed cotton, but a yield over 450 lb. is not impossible.

Two experiment stations in Kaiyuan are now engaged in breeding new strains and conducting various cultural experiments. They are the Tree-cotton Experiment Station of the National Agricultural Research Bureau and the Yu-Yun Cotton Station founded by the Yu-Tien and Yunnan spinners. Some of their results are very encouraging. Hybrid lines between several varieties showed greater vigour which resulted in higher yield, and a better quality in seed cotton was found in most instances. The cotton plant responded well to the use of fertilizers and mulching. The most destructive insects are suppressed to a certain extent by dusting with DDT and other insecticides, the treated plots giving significantly better yields. Weeding in the monsoon season and picking the crop twice a year are the most tedious operations and are both important items in the cost of production. Equipment and chemicals facilitating such work would be greatly welcomed by the farmers. We have tried sodium chlorate on a number of noxious weeds: the speargrass (*Imperata* sp.) and nut-grass (*Cyperus rotundus*) were apparently not affected by the spray, and Spanish needles (*Bidens bipinnata*) had only the younger leaves scorched and recovered in a week or so.

Received July, 1948.

REVIEWS

COLONIAL DEVELOPMENT. FIFTH REPORT FROM THE SELECT COMMITTEE ON ESTIMATES, 1947-48. (H.M.Stat.Off. 1948. 1s. 6d. net).

The Select Committee of the House of Commons on Estimates discuss in this paper the results of their inquiry into Colonial Development. The Estimates concerned include votes of £4,310,000 for Development and Welfare and of £3,400,000 for the production of groundnuts in East and Central Africa by the Ministry of Food. In order to obtain first-hand information on the progress of Colonial Development Nigeria was selected as an example, and a sub-committee made personal investigations in that country.

After reviewing the various Acts providing for Colonial Development and governing the application of the funds made available the Committee point out that actual expenditure has fallen far short of the sums annually made available, and declare that this fact demands urgent and fundamental examination. Colonial governments have been asked to draw up ten-year plans for submission to the Secretary of State, and seventeen of these plans involving an expenditure of £180,000,000 have been approved. About one-third of this sum is to be contributed from United Kingdom funds and the remainder from Colonial resources.

The Nigerian plan contemplates an expenditure of £55,000,000 (£23,000,000 from the C.D.W. Act) and includes £9,000,000 for building, £8,000,000 for water supply, £7,000,000 for roads, £6,000,000 for medical services, £5,000,000 for education, £3,500,000 for marine development, and £3,250,000 for agriculture, forestry and veterinary services. All this is additional to the normal expenditure, amounting to some £20,000,000 a year, much of which is devoted to the same ends. Forms of development other than government services have no place in the Plan. In the words of the Committee, " The allocation of expenditure on the Ten-year Plan therefore does not give anything like a complete picture of the future development of the territory. The Plan does not propound a complete strategy of development; it is merely an aggregate of proposals for spending the money." It is not enough merely to ask the heads of departments to put forward their suggestions for spending their share, however urgent and desirable the objects of such expenditure may be, without some attempt to appreciate the situation or to define the objectives. " This," remark the Committee, " is not planning."

In their general conclusion on this subject the Committee say, " The emphasis in existing plans on the expansion of government departments is the natural result of planning from the top. In a democratic approach one starts with the colonial peoples themselves, their needs and their potentialities. The Colonies are poor because the people have not learned how to master their environment. Techniques and tools are primitive, hygiene deplorable, and conditions too frequently accepted as inevitable when knowledge and the right tools could improve them. Rapid and effective progress requires the introduction of methods of communal development in water supply,

agriculture, hygiene, domestic living, cultural values, self-help and democratic organization. . . . A large scale advance in agriculture means reaching into every village, forming farmers' groups and agricultural societies, demonstrating new techniques on farmers' holdings, promoting co-operatives and providing fertilizers, improved tools and cattle."

In a section headed Materials and Men the Report discusses in considerable detail the admitted difficulties in supply and makes suggestions as to the means of reducing them. It is pointed out that in May, 1948, there were 1,185 vacancies in the Colonial Service, a number which includes 110 agriculturists, 48 in West Africa and 41 in East Africa. (Something of the effect of this last-mentioned shortage may be gauged from the statement made elsewhere that in Nigeria there are two qualified agricultural officers for every million inhabitants, of whom 95 per cent. gain their livelihood from the land.) To meet the present shortage the Committee recommend that recruitment outside the field of university graduates could be extended with advantage, and that short-term secondment of technical officers from home to colonial services might be facilitated.

On agricultural development in Nigeria the Committee issue a warning of the possibility that the maintenance of exports, even at their present level, may endanger the food supply of a rapidly increasing population on a soil declining in fertility, and they call for a survey of production and a census to provide basic information on this question. They attach the greatest importance to the extension of co-operative societies. Producers' societies, whether co-operatives or corporations, which can secure fair and stable prices, and also supply technical assistance and machinery, are the key to contentment and progress. In the absence of consumers' societies the African peasant is, in the present shortage, at the mercy of middlemen and is discouraged from increasing output.—Ed.

Report of West African Oilseeds Mission. (Colonial No. 224. H.M.Stat.Off. 1948. 1s. 6d.) This is the Report to the Secretary of State for the Colonies of a mission of four, including Mr. G. F. Clay, Agricultural Adviser to the Colonial Office, appointed "to investigate the suitability of areas in the Gold Coast, Northern Nigeria and the Gambia, for large-scale mechanical production of groundnuts, and if conditions are considered suitable to make recommendations as to the methods of production to be adopted so as to ensure the full co-operation of the local inhabitants, due regard being paid in any such recommendations to the social and economic effects on the territories concerned."

Although the attentions of the Mission were specifically directed to groundnuts, there is much in their report of interest for cotton growers. In the first place because, at the request of the Colonial Office, the Mission has been followed over its ground by Messrs. Hutchinson and Pearson of the Empire Cotton Growing Corporation staff, to advise on the possibilities of developing cotton as an alternative crop; and in the second because the direction given in the terms of reference that due regard must be given to native interests and co-operation, has

EMPIRE COTTON GROWING CORPORATION

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led to considerations of organization and methods of production which apply equally to the development of cotton-growing in these areas and elsewhere.

The Mission avoided existing areas of agricultural production as introducing too many complications into what must be an experimental approach, and looked, in the comparatively small proportion of land unoccupied or sparsely populated, for tracts of land of suitable extent which, for reasons such as the lack of water for domestic purposes, the presence of tsetse fly, or the reduction of population through the activities of slave raiders in bygone days are not now being cultivated but appear capable of development. Provisionally, four such areas of approximately 2,000 square miles each were found, two in the Gold Coast north of Kumasi, and two in Northern Nigeria. In Gambia an area of 30,000 and another of 5,000 were found. Mainly for political, but partly for technical reasons the Mission considers that the best method of development in these areas is by the establishment of a number of village units, at first comprising paid labour, but ultimately practising collective or group cultivation assisted by mechanization. The limit of production with primitive implements having been already reached it is only by mechanization that a greater acreage per family and a higher degree of efficiency in production can be achieved. The danger of encouraging a greater production of export crops under present conditions was exemplified to the Mission in Nigeria, where the "groundnut drive" had led to grain shortage and might well have led to famine. The Mission considers that the intermediate stage—mixed farming by the use of cattle for draught and the making of manure—is capable only of very slow development, and has been overtaken by the machine. The use of artificial manures by natives is regarded as having been made possible by the economy of "placement" planting and now appears a practicable and economic proposition.

The suggestion is made that Governments concerned should establish experimental units in all main producing areas so that a suitable technique of mechanization in respect of local crops can be worked out and demonstrated to African farmers. In the body of the report this recommendation is specifically applied to cotton cultivation in Nigeria, and the neighbourhood of Funtua suggested as a suitable site.—Ed.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA AND IN PAKISTAN

413. INDIA AND PAKISTAN. TRADE AGREEMENT. (*Cott. and Gen. Econ. Rev.*, 25/6/48.) A trade agreement has been reached between the Dominions of India and Pakistan whereby India will supply, *inter alia*, 400,000 bales of cotton yarn and cloth, 50,000 tons of jute manufactures, and 1,100,000 lb. of woollen and worsted goods. Pakistan has agreed to give India mainly 175,000 tons of food grains, 5,000,000 tons of raw jute, 650,000 bales of raw cotton, and a quantity of rock salt. The agreement comes into operation during the period July 1, 1948 to June 30, 1949, except in the case of raw cotton and cotton textiles, where the period is September 1, 1948 to August 31, 1949.

414. PAKISTAN. COTTON INDUSTRY. (*Int. Cott. Adv. Comm., Washington, D.C.*, August, 1948.) Official encouragement is being given to an expansion of cotton acreage, but there is reported to be an insufficient number of experienced cultivators, and it is uncertain whether the acreage will be larger than last year. . . . There appears to be scope for a large increase in cotton acreage, but the availibity of irrigation waters and the rate of water logging and salting of the land are two factors affecting the long-term outlook.

415. INDIAN CENTRAL COTTON COMMITTEE. (*Ann. Rpt.* 1946-47. Received 1948.) In the twenty-sixth annual report the progress made in the various spheres of the Committee's activities is reviewed. Twenty-five research and nineteen seed multiplication and distribution schemes, mainly financed by the Committee were in operation. Progress was continued in the introduction of improved varieties of cotton in ten Provinces and States. The various Acts passed for the regulation of transport, marketing, ginning and pressing of cotton, and the prevention of the introduction of foreign cotton pests, functioned satisfactorily during the season. Summaries are given of the research in connection with cotton genetics and plant breeding and physiology carried out at the Indore Institute of Plant Industry, and the work of research and testing sections of the Technological Laboratory at Matunga, Bombay.

416. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS, 1947. By D. L. Sen. (*Tech. Bull. Series A, No.* 67, Ind. Cent. Cott. Comm., 1947.) The usual agricultural details, grader's report, fibre particulars, spinning tests and remarks are given for seventeen cottons tested. Six cottons showed an improvement over last season, which was appreciable for Gadag 1, L.S.S. Cambodia Co. 3 and Hagari 1. Six cottons gave practically the same result as last year, while five cottons—including Sind Sudhar, Sind M4, Sind N.R., V.434 (Akola), and Gaorani 6—registered a falling-off in spinning performance.

417. TECHNOLOGICAL REPORTS ON TRADE VARIETIES OF INDIAN COTTONS, 1947. By D. L. Sen. (*Tech. Bull. Ser. A, No.* 68, Ind. Cent. Cott. Comm., 1947.) The valuation reports of the Standards Committee and of the Special Appeal Committee and the spinning test results are given for varieties of cotton mainly supplied by the East India Cotton Association, and the grader's report and spinning test results for varieties supplied by the Ahmedabad, Bombay, and Southern Millowners' Associations; the Department of Agriculture, Madras; Indore; and the Karachi Cotton Association.

418. BOMBAY COTTON ANNUAL, 1946-47. (East India Cotton Asson. Ltd., Bombay, 1948. Price Rs. 4.) This is the twenty-eighth issue of this authoritative compendium of all matters relating to every branch of the cotton trade. The first

section contains the Twenty-sixth Annual Report of the Directors of the East India Cotton Association Ltd., for the 1946-47 season. This is followed by numerous statistical tables of acreage, production, ginning returns, imports, exports, consumption, stocks, prices, and textiles; Government notices, etc. The publication is designed to meet the requirements of all who are interested in the production, distribution, and consumption of Indian and foreign cottons, yarn and cloth.

COTTON IN THE EMPIRE

419. CANADA. COTTON INDUSTRY, 1948. (Int. Cott. Adv. Comm., Washington, D.C., August, 1948.) Consumption in Canadian cotton mills in June was 31,600 bales, compared with 27,800 bales in June, 1947. . . . Imports into Canada in May totalled 32,000 bales, of which 44 per cent. was Mexican cotton, 43 per cent. United States, and 10 per cent. Brazilian. Since the removal of subsidies and controls, textile prices have moved upward, and there have been reports of consumers' resistance to the higher prices.

420. ASIA. CYPRUS: COTTON INDUSTRY, 1946-47. (*Ann. Rpt. Emp. Cott. Grwg. Corpn.*, 1946-47. Issued 1948.) The area sown with cotton was below the average owing to the lack of late spring rains. The growing season was, however, favourable and the crop was relatively free from bollworm. The area sown was estimated at 5,700 acres, and the production 2,000 bales.

421. TEXTILES. (*Overseas Rev.*, Barclays Bank Ltd., June, 1948, p. 16.) The Government is now proposing to release all stocks of textiles accumulated by it during the war, and estimated to be worth some £400,000. A committee of local merchants has been formed to purchase this stock, and negotiations regarding prices are still proceeding. The textile market is considered, however, to be well stocked generally and over-stocked in certain lines.

422. AFRICA. GOLD COAST: COTTON INDUSTRY, 1946-47. (*Ann. Rpt. Emp. Cott. Grwg. Corpn.*, 1946-47. Issued 1948.) The area under cotton in Togoland was approximately 1,000 acres, most of which was interplanted with maize. The total production of some 75 tons of seed cotton was absorbed by the local industry, and owing to the high prices of cotton piece goods the demand for lint has been strengthened. A certain amount of cotton is grown for local use in Ashanti and the Northern Territories, while in the Accra Plains perennial cotton is cultivated to a small extent.

423. KENYA COLONY: COTTON INDUSTRY, 1946-47. (*Ann. Rpt. Emp. Cott. Grwg. Corpn.*, 1946-47. Issued 1948.) 1946-47.—In Nyanza Province the climatic conditions during the planting and growing periods were very favourable, but a potentially good crop was spoiled by disease and unfavourable weather at harvest. *Lygus* and blackarm destroyed much of the early crop, and stainers, which appeared during October and increased greatly towards the end of the year, caused severe damage. In the Coast Province the growing season was one of the best recorded, and heavy rain which occurred just before fruiting was most favourable to heavy cropping. Pests and diseases caused little damage, except for a slight attack of stainers towards the end of the year.

1947-48.—The yield in Nyanza Province has been seriously affected by drought. This has caused heavy boll shedding and has precluded the possibility of a crop from the second flowering. In the Coast Province the prospects are good, but average yields per acre will not be up to the previous season's standard. The "short rains," which are normally expected in November, failed, and there will be no second flush.

424. COTTON CROP, 1947-48. (*Cott. and Genl. Econ. Rev.*, 13/8/48.) The cotton crop of the season was about equal to the 1946-47 crop of 4,000 bales. All except 111 bales of the 1947-48 crop were graded as AR (top) quality.

425. NIGERIA: PROGRESS REPORT ON COTTON GROWING, 1946-47 SEASON. (*Prog. Rpts. from Exp. Stats.*, 1946-47.) *Northern Provinces.*—Rainfall during the year was good for cotton growing, but pink bollworm is now a recognized pest in Northern

Nigeria, and may have caused some damage. Yields on the experimental farm were normal. Strain Samaru 26c was multiplied up at Daudawa. It has given satisfactory results and was distributed to farmers for the first time in 1947. The area chosen for this distribution is that in the immediate vicinity of Daudawa. This is a change in policy, as previously seed from Daudawa Stage II was sent to farmers in the Awai district. A mulching trial was carried out but no increase in yield was gained by it. Topping caused a significant reduction in yield. In variety trials carried out at Daudawa and on the school farm at Samaru no significant differences were obtained. In a factorial experiment combining dates of sowing, spacing, and number of plants per stand, planting on September 15 gave a significant reduction in yield. Although the differences between cotton planted July 4, July 25 and August 5 were not significant, there was a trend towards higher yields with earlier planting. Spacing at 15 inches proved to be the best, regardless of the date of planting, and when planted at 15 inches the best yield was obtained by leaving three plants per stand.

Western Provinces of Southern Nigeria.—Botanical work at Ibadan was rendered extremely difficult through failure of the normal rains. The exceptionally dry conditions combined with insect attack had a disastrous effect on yield. Attack by *Helopeltis* and leaf-roller was severe, though kept down as far as possible by hand-picking. A few plants showed leaf-curl and were removed. Damage by pink bollworm was also severe, causing a loss of about 60 per cent. of the seed produced. The final yield of seed-cotton was at the level of 90 lb. per acre, as against the normal yield in these plots of 400 lb. per acre. The self-pollinated seedlings of 16 plants, selected from the highest yielding selection of the previous season, were grown in progeny rows of 40 plants each, spaced 5 ft. apart on ridges at intervals of 6 ft. Plants were selfed and 8 rows were chosen for their halo length and ginning percentage to provide seed for continued selection in 1947.

426. COTTON INDUSTRY, 1947-48. (*Half-Yrly. Rpt. to June*, 1948.) *Northern Provinces.*—Purchases for export in 1947-48 were very disappointing, being 13,185 bales less than the previous season's exports. Later planted cotton, especially in Southern Katsina, yielded somewhat better than expected in spite of the early cessation of the rains, and quality was generally good. Sixty-three per cent. of the exportable crop came from Katsina Province. Purchases in Sokoto, Zaria, and in the Kontagora area of Niger Province were considerably less than in the previous year. In Bauchi Province the total purchases for export only amounted to 13 bales from a seed distribution of over 300 tons. Native ungraded cotton from Benue Province, however, showed a marked rise in export purchases, and it is estimated that 3,000 bales will be available, which is nearly double the previous season's total. Export buyings now represent only 3·2 bales (400 lb.) per ton of seed issued, compared with 5·6 in 1946-47, 7·8 in 1945-46, and 10·2 in 1939-40. The heavy fall in purchases was largely caused by the exceptional demand from the native trade, leaving only a small proportion of the crop for export. This clearly illustrates the extent of the demand which has arisen for cotton used by the local spinning and weaving industry during and after the war, caused by scarcity of imported cotton goods. The average local price for seed cotton has risen to over 4d. per lb. In Bauchi Province the local price was as much as 6d. per lb. The ginnery price offered for Grade I cotton was raised from 3d. to 3½d. per lb. at the end of February, but too late to have any effect on total purchases for export. In addition to the demands of the local spinning and weaving industry, large quantities of cotton passed into French territory, especially from the Northern and North-Western districts of Sokoto.

The question of combating bollworm attack, which is still on a serious scale, is now being actively taken up. Recommendations for dealing with this problem have been framed by Mr. J. B. Hutchinson and Mr. E. O. Pearson, of the Empire Cotton Growing Corporation, who visited Nigeria at the end of 1947. The Corporation has already sent out an entomologist to conduct full scale investigations. He will be posted to the Northern Provinces for two years, and though his work will

at first be concentrated on the study of bollworm in cotton, he will later make investigations into other pests of the crop.

The ginning percentages of the crop showed a further improvement over the previous season at all ginneries except Mallam Fashi. The percentage of Grade I cotton was 93·5 of the total purchases, compared with 91·5 in 1946-47.

Multiplication of the Botanist's selection Samaru 26C was again carried out at Daudawa Farm. This strain has now reached stage 3 in the multiplication scheme, where seed was distributed for the first time last year to villages around Daudawa which have been scheduled as a special multiplication area. Some 2,500 acres were grown, and a special cotton market was opened at Daudawa, the crop being purchased by the Katsina N.A. in the first instance. A total of 160 tons was purchased.

For the 1948-49 season more seed has been issued than for last year, probably due to the annnouncement that prices will be advanced next buying season to 4d. per lb. for Grade I and 3·9d. per lb. for Grade II. It is expected that the final distribution of seed will be well over 6,000 tons, and, given a good growing season, there should be a large crop in 1948-49.

Western Provinces.—Yields from the 1947-48 cotton crop were fair, but considerably above those of the 1946-47 crop, which was much below average. Damage by *Helopeltis* and pink bollworm was again severe, although there may have been some slight improvement in Abeokuta Province as a result of intensive propaganda for the uprooting and burning of the previous season's crop. The local demand for seed cotton throughout the Western Provinces continues, with prices rising to 6d. per lb. So long as this demand persists the prospects of reviving the export trade in cotton from this area, now virtually dead, appear to be slight.

In the Meko area the rainfall was considered inadequate for extensive planting. Germination of seed already planted is reported to be good. In Oyo Province June rainfall was satisfactory, and good germination is reported.

427. COTTON INDUSTRY, 1948-49. (*Overseas Rev.*, Barclays Bank Ltd., May, 1948.) Farmers in Nigeria are anticipating a rise in prices, and there has been an increased demand for cotton seed for sowing.

428. LOCALLY WOVEN CLOTH. (*Crown Col.*, July, 1948, p. 394.) Locally woven cloth of all types may now be exported. The ban on export was cancelled as from May 1.

429. NYASALAND: WORK OF THE DOMIRA BAY STATION, 1946-47. (*Prog. Rpts. from Exp. Stats.*, 1946-47.) The possible advantages of an early start to the rains were nullified by continuous wet and sunless weather, and it is probable that the crops suffered from nitrogen starvation. The poor yield of cotton and even poorer yield of maize, compared with the relatively good return from groundnuts, are suggestive. Sorghum suffers less than maize in a poor season, and in addition to having possibilities as a rest crop merits more consideration as a food producer on the station than it has been given to date. Mixed cropping of cotton and maize gave inconclusive results, but more investigation is justified. Soil "crumb" structure studies have been begun, and it is suggested that the Station soils may exhibit some specialised features. Cotton work has proceeded on familiar lines, and the "sifting" of our main varieties has made good progress. Trials show that the present commercial bulk cotton is still capable of good yields and satisfactory lint quality. Attempts to control red bollworm with DDT 5 per cent. dust have not proved successful. There was more bollworm loss this year. Blackarm does not appear to be a limiting factor under the conditions of the past season, but a direct comparison between the yielding power of susceptible and resistant types of cotton of the same parentage will be made next season.

430. COTTON INDUSTRY, 1946-48. (*Ann. Rpt. Emp. Cott. Grwg. Corpn.*, 1946-47. Issued 1948.) Despite unfavourable weather in the 1946-47 season the cotton crop was on the whole satisfactory, and considerably larger than that of the preceding year.

As a result of the high prices to the grower in 1947, there is an enhanced interest

in cotton in the new season. A substantial increase in acreage is expected. Considerable difficulty has been experienced in the delivery of seed owing to the shortage of bags, and if the crop should prove particularly heavy there may also be a shortage of baling materials.

431. COTTON PROSPECTS, 1948. A report from the Department of Agriculture for the month of June is to the effect that in the main cotton-growing area of the Lower River the crop is considerably earlier than last year, good growth continues and picking is now general. A good crop of clean cotton is expected in the Blantyre and Fort Johnston districts, but in the Nalikolo locality the yield will only be fair. Marketing of the Central Province cotton will commence in August.

432. COTTON CROP PROSPECTS, 1948. (*Overseas Rev.*, Barclays Bank Ltd., June, 1948.) The official estimate of the cotton crop in the central and southern provinces is from 7,000 to 7,500 short tons of seed cotton, while harvesting reveals that the crop is clean and of good quality.

433. SOUTHERN RHODESIA: COTTON INDUSTRY, 1946-48. (*Ann. Rpt. Emp. Cott. Grwg. Corpn.*, 1946-47.) The 1946-47 season was one of very severe drought, which affected the greater part of Rhodesia. Total production of lint was lower than it had been for a number of years. One reason for the decrease was that with the present price levels, cotton was a much less attractive crop than either maize or tobacco. As the value of the cotton crop in mixed farming becomes better known to Africans, it is hoped that there will be, in the future, a steady and sustained increase in production from this source. The Development Co-ordinating Commission under the chairmanship of Sir Miles Thomas has recommended in its first interim report that a campaign to popularize cotton growing by natives should be instituted.

In the 1947-48 season there was a marked increase in the amount of seed issued for planting to both European and African growers, more especially to the latter. Rains at planting were generally good and the climatic conditions since then have been favourable to the development of the cotton plants. Reports received at the end of February indicated that flowering and bolling were good, and that yields per acre and total production were expected to be appreciably better than in the previous season.

434. SOUTH AFRICA: COTTON INDUSTRY, 1946-48. (*Ann. Rpt. Emp. Cott. Grwg. Corpn.*, 1946-47.) In spite of the fact that climatic conditions were, on the whole, more favourable than during the previous years, the 1946-47 crop was affected by drought shortly after planting, and wet conditions in January and February caused considerable shedding. Nevertheless, the total production of 1,113 bales was the highest recorded in the Union since 1940-41, and the standard of lint was very good. Owing to the advance in price farmers have shown a greater interest in cotton, and a much larger acreage has been planted for the 1947-48 season. Writing at the end of January the Senior Cotton Grader in the Union said that good rains had given the crop an excellent start, and providing weather conditions were not adverse, the crop should be the largest reaped for a number of years. A further impetus to future cotton production has been given by the following two facts: (1) the continued drop in the prices received by the producer of vegetables, and (2) the establishment in the Union of textile industries which are capable of absorbing all the cotton South Africa can hope to produce for many years.

In the Low Veld about 4,000 acres were planted with cotton for the 1947-48 season compared with 1,800 last season and 900 in 1945-46. Damage by American bollworm was severe on individual farms, but the attack diminished and a good late crop was set. Angular leafspot and blackarm were more prevalent than usual, probably because of the heavy rainfall and high humidity. In the Magut area tsetse fly has caused the death of thousands of head of cattle in recent years, and this has caused farmers to show a greater interest in cotton growing as an alternative form of livelihood. About 1,500 acres in this district were planted with cotton at the beginning of the present season.

At the Barberton Station, Transvaal, the season 1946-47 was one of the best ex-

perienced during the past twenty years, and cotton yields were high, thus enabling seed reserves of valuable strains, which had been reduced to dangerously low levels by hail damage in the previous season, to be built up again. As in all trials since 1943-44 in which it has been included, Cambodia × U.4 selection A.2106 significantly outyielded 5143, the strain at present in general cultivation, the mean difference for all trials being as high as 46 per cent. Sufficient seed was made available for the 1947-48 season for growers in the Barberton, Swaziland, and Zululand areas. The major part of the breeding work was again confined to the quality crosses between U.4 types and longer linted cotton, with a view to securing improved quality in conjunction with the heavy fruiting and jassid resistant characters of the U.4 parent.

435. ANGLO-EGYPTIAN SUDAN: COTTON INDUSTRY, 1947-48. (*Ann. Rpt. Emp. Cott. Grwg. Corpn.*, 1946-47. Issued 1948.) *Sakel Cotton.*—In the Gezira the following areas of cotton were sown by the Sudan Plantations Syndicate and the Kassala Cotton Company: Domains Sakel, 113,949 feddans, X.1730, 92,397 feddans, a total of 206,346 feddans. The crop looked promising at first but fell away in October. 34,092 feddans were sprayed against jassids, with good results, but the crop is very uneven, and the overall yield is estimated at a little over 3½ kantars per feddan. In the Tokar Delta a yield of 100,000 kantars was estimated at the end of 1947, but from recent advices it would appear that the yield will be less than this. In the Gash Delta 33,240 feddans of cotton were planted, the estimated yield being 64,371 kantars. On Government Schemes, at Abdel Magid 9,995 feddans were sown with X.1730A, and the Pump Schemes with 6,047 feddans of Sakel cotton. Except at Hashaba rains were light, and there was little difficulty in establishing the crop. The overall yield will probably be about 3½ kantars per feddan. All schemes on Private Estates are growing X.1730A, and the area under crop is 15,483 feddans, which is a slight increase over last year. The overall figure for yield is estimated at 3.4 kantars per feddan, which is slightly less than last year.

American Rain-Grown Cotton.—In Kordofan there was a large increase in area in 1947. 22,717 feddans were planted, estimated to yield 26,400 kantars. The demand for seed for sowing in 1947 augurs well for a further increase in area in 1948. In the Equatoria Province also there was an increase in the area sown to cotton. The rains of 1947 were most unsatisfactory and drought at the end of the year caused serious damage. The Meridi cotton, BAR SP/84, is expected to produce 3,800 kantars and the Yambio cotton, also BAR SP/84, should yield about 8,000 kantars.

436. SUDAN COTTON CROP, 1948. (*E. Afr. and Rhod.*, 19/8/48.) Gross proceeds of the Gezira cotton crop in the Sudan are expected to reach £E11,725,000 from lint cotton, £E52,500 from scarto, £E37,500 from rollers and lugata, and £E1,755,000 from cotton seed. A total yield of 700,463 kantars from 206,346 feddans averages 3·395 kantars per feddan. The 40 per cent. share of net profits due to tenants is estimated at £E4,690,000 from which loans amounting to £E690,000 will be deducted. The average payment will be £E194 for the average 10-feddan tenancy. In order to avoid the inflation which would be caused by payment of so great a sum, it has been decided to spread distribution over four instalments, due in July, September, and December, 1948, and April, 1949. Tenants will receive nearly £E1,000,000 more than last year.

437. COTTON EXPORT DUTY. (*Crown Col.*, July, 1948, p. 393.) The rate of export duty on raw cotton and cotton seed has been increased from 3 to 5 per cent. *ad val.* It is considered that, as cotton lint and cottonseed now command very high prices, they can fairly be called upon to bear the additional duty.

438. TANGANYIKA: COTTON INDUSTRY, 1946. (*Ann. Rpt. Dpt. Agr.*, 1946. Received 1948.) In the Lake Province the rainfall was satisfactory for the later maturing cotton crop, and the total yield was not much below the average. There was a slight improvement in the output from the other cotton-growing Provinces, due to increased plantings, though the total acreage was much reduced owing to

the necessity to concentrate on the planting of food crops. In the Rufiji, for instance, all available flood-land planting areas were utilized for maize and pulses. In the Southern Province most cultivators were too preoccupied with retrieving the dangerous food situation to give much attention to cotton planting. Red bollworm was identified in the Southern Province, and in view of the very serious danger to the East African cotton industry if this pest were to spread northwards, the Cotton Board took the severe step of recommending to Government that cotton production should be excluded from the Province in the area south of the Rufiji and Kilwa Districts border and north of the Lindi-Tunduru road. This would result in the Kilwa ginnery ceasing to function, and a considerable decrease in the seed cotton normally available to the Mtua (Lindi) ginnery.

439. COTTON INDUSTRY, 1947. (*Ann. Rpt. Emp. Cott. Grwg. Corpn.*, 1946-47. Issued 1948.) In 1947 the rains were exceptionally heavy, and in many areas damage was caused by waterlogging. In the Lake Province the crop was slightly below average, and blackarm and jassid damage was severe. In the Eastern Province a slight increase in crop over the past two years was recorded, and although it was still well below the average of the war years, it was better than was at one time expected when neglect to pick the crop was attributed to lack of trade goods in the shops. The quality of the crop was, however, particularly good. In the Southern Province the very wet season diverted the attention of cultivators to their food crops and planting was restricted on account of red bollworm. Pests and diseases took a heavy toll. In the Tanga and Northern Provinces the season was disappointing, partly on account of excessive rain and partly because a food shortage in the previous year caused growers to concentrate on food production.

440. COTTON PROGRESS REPORT, 1948. The report from the Department of Agriculture for July states that marketing of the Lake Province crop started in the second half of July and heavy sales have been reported at Mwanza and Maswa markets. Total purchases of raw cotton at the end of the month were the equivalent of 21,650 bales of 400 lb. net. In the Eastern Province cotton prospects are better than last year in most areas, the exceptions being in the Rufiji, where unnecessarily late planting has resulted in a reduced crop, and in Kilosa where rain is needed to mature the crop. The Tanga Province cotton crop is greater than for some years. No damage from pests or diseases has been reported.

441. WORK OF THE EXPERIMENT STATIONS, 1946-47. (*Prog. Rpts. from Exp. Stats.*, 1946-47.) *Ukiriguru and Lubaga Stations.*—Crops were fairly good on the whole, in a year of exceptionally heavy rains, but cotton suffered from jassid, blackarm, and in places, waterlogging. Late-planted cotton yielded poorly. Last year's provisional conclusion that at Ukiriguru, on light land, the benefits from a three-year grass rest had been dissipated on one year's cropping has to be modified; a significant benefit has reappeared in the third year. The benefit from 7-ton manurial applications was noticeable in the third and fourth years on the light Ukiriguru soils. In N.P.K. trials the effect of nitrogen was large, of phosphate small and of potash negligible. The micro-plot technique promises to be useful. Tie-ridging was still of value to yield, even in a year of heavy rains. Jassid damage was heavy in most areas, and jassid-resistant strains showed to real advantage. Better jassid-resistance was doubtless the main reason for the superiority of the new strain mixture. U.K.46, over the commercial Mz.561, which it is to replace. U.K.46 outyielded Mz.561 by an average of 25 per cent. in 17 trials throughout the cotton belt. Blackarm was widespread, and the next proposed issue of seed to follow U.K.46, another mixture, has blackarm resistance as one of the main aims. Shambat is helping with the work on blackarm.

Other strains which gave good performances during the year included a derivative of Uganda B.P.50, which yielded well and had better jassid resistance than most B.P.52 derivatives. M.U.8 was also among the yield leaders of the year. Of its derivatives from crosses with Barberton U.4's, A.2195 was rather better than A.2208, although neither was as good as the M.U.8 parent in the field.

Eastern Province.—The testing of different varieties and strains at Ilonga and the

six district plots was repeated, particularly with regard to their reaction to insect pest attack. The variety trial of the previous three seasons was planted again. The types used were Eastern Province Local; Uganda B.P.52; Mwanza 561; B38/9, a selection from Eastern Province Local; and M.U.8A, a selection from Malwa Upland. The last was included on account of its high rate of flowering and early maturity. Insect attack was very variable over the whole series, but a combined analysis showed that M.U.8A and B38/9 were significantly better in yield than Local.

The chief pests and diseases encountered during the season were American bollworm, jassid, pink bollworm, spiny bollworm, stainers, *Callidea*, *Helopeltis*, *Lygus*, and blackarm disease.

442. UGANDA: COTTON INDUSTRY, 1946-47. (*Ann. Rpt. Emp. Cott. Grwg. Corpn.*, 1946-47.) The cotton crop was planted under good conditions, and gave promise of satisfactory yields. Unfortunately these were not realized as the autumn rains were unduly prolonged, and in consequence the ripening crop suffered considerable damage and loss. The grade and quality were also affected to a marked extent, and the standard was low.

1947-48 *Season.*—Weather conditions being unfavourable for early planting, the bulk of the crop was planted late. The previous wet season was responsible for damage to seed stocks by heating, and in consequence considerable seed replacement was required, which delayed planting still further. The final acreage planted was some 18 per cent. less than that of 1946-47.

443. COTTON PROSPECTS, 1948-49. (*Cott. and Genl. Econ. Rev.*, 30/7/48.) A report from the Department of Agriculture states that the acreage planted to cotton to the end of June amounted to 565,975 acres, as against 167,385 acres at the same date last year. In the Eastern Province weather generally was favourable to planting and growth. The condition of the crop is excellent. If weather in July and August is favourable there is every prospect of the final acreage exceeding that of last season's total by a considerable margin. A satisfactory acreage has been sown in the Western Province, and both germination and growth are good. In the Northern Province rainfall was generally adequate and well distributed and favoured planting and growth; a final acreage well above last year is anticipated. In Buganda Province germination has been excellent, and the standard of cultivation is reported to show considerable improvement. The demand for seed continued keen, and in some areas it was necessary to reserve additional quantities for planting.

444. COTTON PROSPECTS, 1948-49. (*Cott. and Genl. Econ. Rev.*, 23/7/48.) Growers have responded well to the Government's campaign for early planting of cotton. With the added inducement of an increase in price from last year of 8 cents per pound, a large acreage has been planted, and, given favourable weather in October and November, there seems a possibility of a crop of over 300,000 bales. These figures can, of course, be more than halved by unfavourable weather during the last month or two of the growing period.

445. COTTON AND COFFEE FUNDS. (*Crown Col.*, July, 1948, p. 390.) Plans which had been tabled for closing the Cotton and Hard Coffee Fund, and distributing the £10,500,000 standing to its credit, were withdrawn at the session of the Legislative Council held on April 27. Withdrawal of the motion met with general approval, as the public had not had an opportunity of contributing their views as to the manner in which the allocation should be made.

446. AUSTRALIA. COTTON INDUSTRY. (*Ann. Rpt. Emp. Cott. Grwg. Corpn.*, 1946-47.) Drought, labour shortages and favourable prices for competing crops have been largely responsible for keeping cotton production during the last few years at only one-fifth of the pre-war average. There is, however, a large unsatisfied local market for cotton, and for the 1947-48 season the Cotton Marketing Board launched a campaign to increase the area planted in Queensland. The result was not as good as had been expected, the area finally planted being about 10,000 acres, an increase of approximately 1,300 on the previous year. Good rains during the period September-November, following an exceptionally dry winter, enabled

the 1947-48 crop to make a promising start. Unfortunately, dry conditions set in at mid-December and continued until the end of February. This caused considerable loss of crop through bud and boll shedding, and it is unlikely that much will be reaped in the way of a top crop. At the present time Queensland is importing about 90,000 bales a year for the local mills, and there is a great opportunity to establish a sound and efficient cotton-growing industry. This, however, is only likely to be brought about by irrigation and the complete mechanization of cotton growing and harvesting. At present, the bulk of the requirements of Australian spinners fall within the range of American $\frac{15}{16}$ inch cotton. Some $1\frac{1}{8}$ inch to $1\frac{3}{16}$ inch Mississippi types have been brought in for special purposes, and some Egyptian Uppers for the manufacture of tyres for motor vehicles. About 2,000 bales of Peruvian mid-rough are also imported each year for mixing with wool to produce certain types of woollen garments.

447. QUEENSLAND: COTTON INDUSTRY. (*Cott. and Genl. Econ. Rev.*, 6/8/48.) As a result of the war and post-war conditions, the production of cotton in Queensland has declined to a very low level, and at the present time there is very little prospect of any favourable change in the situation which would result in an immediate increase of production. The problems facing the cotton-growing industry in the State are: the acute shortage of labour in rural areas, and the fact that all food products have a No. 1 priority, the farmers receiving very high prices for such primary products. In spite of the difficulties, the industry and the State Government of Queensland have embarked on a long range development plan for the cotton-growing industry. This is based mainly on improved cultural methods and intensive mechanization of cotton production under dry farming conditions, and water conservation and irrigation developments for the production of cotton under irrigation wherever possible. The Cotton Marketing Board and the Queensland and Commonwealth Governments have imported from U.S.A. one of the improved spindle type cotton harvesting machines which are now being made under mass production methods in America. This machine was tried out in June in the main cotton-growing area, and harvested cotton at the rate of 400 lb. of seed cotton per hour in a crop which was yielding about 600 lb. of seed cotton per acre. To harvest this amount of seed cotton by the hand-picking method would require from 25 to 30 man-hours' labour; that is, the machine under these conditions does the work of 25 to 30 workers.

In the cotton textile industry of Australia, the principal problem is one of an acute shortage of labour to operate the mills on 100 per cent. efficiency. A new cotton spinning mill has been erected in Brisbane, Queensland, which will commence operations in September, 1948. This will be the first cotton spinning mill to operate in the State, and as far as possible the mill hopes to use Queensland-grown cotton for its mill requirements.

448. WEST INDIES. REPORT OF THE THIRD ORDINARY GENERAL MEETING OF THE WEST INDIAN SEA ISLAND COTTON ASSOCIATION (INCORPORATED). The report contains the minutes of the Third Ordinary General Meeting of the Association held at Friar's Hill, Antigua, from November 24 to 26, 1947. It also contains statistics relating to the British West Indian Sea Island cotton industry.

The members were welcomed by the Acting Governor, who, in his address, stressed the need for increasing Sea Island cotton production, preventing soil erosion, and maintaining soil fertility.

Dr. R. L. Hutson, the new President, paid tribute to the invaluable services rendered to the Association and to all cotton growers in the West Indies over a long period by Mr. C. C. Skeete. Other important matters referred to in the address were: the appointment of the Negotiating Committee for the sale of West Indian Sea Island Cotton to the Cotton Control of the United Kingdom; the initiation by Mr. J. V. Lochrie, Cotton Officer for the West Indies, of a programme of research on soil conservation and fertility at the Cotton Station, Antigua; and the visit of Mr. P. W. Briggs, ginnery engineer, to report on ginning methods and machinery and to make recommendations.

On the occasion of their visit to Antigua to attend this meeting, the representatives of the member Associations had the opportunity of inspecting the Cotton Experiment Station established at Friar's Hill under the direction and supervision of Mr. J. V. Lochrie.

449. Barbados: Cotton Industry, 1946-47. (*Ann. Rpt. Dpt. Sci. and Agr.*, 1946-47. Received 1948.) During the period under review cotton was planted in July instead of in September. This change, representing a shortening of the close season to three months, was made possible since no pink bollworm has been found in the island for seven years in succession. In spite of the encouragement of a shorter close season and an earlier planting date, the request to the Department for seed for planting purposes was sufficient to plant 153 acres only, of which 125 acres were applications from peasants and 28 acres from planters. Actual production amounted to 52,690 lb. seed cotton. Some injury to cotton was caused by the defoliating worm, *Aletia argillacea*, but this was controlled by spraying with lead arsenate. Slight attacks of angular leafspot were also observed during the growing period but did not appear to have affected the yield in any way.

During the season cotton selection work was continued at Codrington Experiment Station, and from previous years' selection the following varieties were selected to carry on the work: B.4204, B.4212, B.4404, B.4301, B.4411, B.4413 with B.1 as standard. These were planted in two variety trials, and the yields proved to be good, the majority of the varieties yielding over 300 lb. lint per acre. Selection of seed for the progeny row selections will be made from the above-mentioned varieties. No selection was made from the 1945-46 plots as it was found that crossing had taken place in the previous crop, and the whole experiment had to be discarded.

450. Cotton Spinning. (*Ann. Rpt. Dpt. Sci. and Agr.*, 1946-47.) In order to determine whether cotton spinning could be established in the West Indies as a secondary industry, the Controller for Development and Welfare undertook to test its possibilities on a semi-commercial experimental basis. Funds for the experiment were provided under the Colonial Development and Welfare Act. A small second-hand plant was purchased and shipped to Barbados; an area of land was leased at a peppercorn rental, and a building was erected to house the plant. In June, 1945, the control of the scheme was transferred to the Government of Barbados and the Director of Agriculture undertook the responsibility for its supervision. Due to unforeseen difficulties, however, the experiment could not get under way until the end of 1946. Early in 1947 the plant was operating on a part time basis and five girls were being trained as operatives. These trainees appeared to learn the necessary operations very quickly.

COTTON IN THE U.S.A.

451. Agricultural Statistics, 1947. U.S. Department of Agriculture. (For sale by the Superintendent of Documents, U.S. Govt. Printing Office, Washington, 25, D.C. Price not stated.) This is the twelfth issue of this publication, prepared under the direction of the Yearbook Statistical Committee. Statistics are included of grains, cotton, sugar, tobacco, oilseeds, fats, oils, fruits, vegetables, melons, tree nuts, coffee, tea, cacao beans; hay, seeds, minor field crops; beef cattle, hogs, sheep, horses, mules; dairy and poultry products; foreign trade of the United States; farm capital and income; agricultural conservation and adjustment statistics; miscellaneous statistics. A table of weights, measures, and conversion factors used in the Department of Agriculture is also included.

452. Cotton Quality Statistics, United States, 1946-47. (*U.S. Dpt. Agr. Prod. and Marktg.*, Cotton Branch, Washington, D.C., 1947. Received 1948.) This report contains information on the quality of cotton ginned during the 1946-47 season, the quality of cotton on hand in the United States on August 1, 1947, and revised figures for the carry-over on August 1, 1946. To facilitate comparison certain data contained in the reports for previous years are included. The report for the carry-over includes statistics on the grade and staple length of Upland and

American-Egyptian cotton and on the staple length of cottons of foreign growth on hand in the United States on August 1, 1947. The tables in this report that contain figures on the tenderability of cotton on futures contracts indicate only the total quantities tenderable and untenderable. All the information given should be helpful to cotton growers and breeders, and to merchants, consumers, research workers, and others interested in the quality of the crop, or the carry-over.

453. California: Cotton Cultivation. (*Supplmt. Coton et Fibr. Trop.* iii, **1**, 1948, p. 1.) The climate, soil, and irrigation possibilities of the San Joaquim Valley, California, are particularly suitable for cotton. Acala cotton was introduced in 1906, and the strain Acala 4-42 is the only one cultivated. This strain was isolated at the Federal Experiment Station at Shaftu, in the San Joaquim valley. The fibre length is from $1\frac{1}{16}$ inch to $1\frac{1}{8}$ inch, and the fibre strength exceeds that of Stoneville and Deltapine cottons.

454. American Cotton Crop, 1947-48. (*Cotton*, M/c., 5/6/48.) The total value of this season's American cotton crop (lint cotton and cotton seed) is computed by the U.S. Government at $2,291,202,000, the second most valuable American cotton crop on record. The record value was the 1919 crop. With regard to the next American cotton crop, news from the South continues favourable, and there is a tendency to raise acreage estimates.

455. American Cotton Crop, 1948-49. (*Cotton*, M/c., 14/8/48.) The U.S. Department of Agriculture forecasts the American cotton crop for 1948-49 at 15,169,000 bales. This forecast compares with 11,851,000 bales harvested a year ago, and 8,640,000 bales two years ago. The average yield per acre is estimated at 313·5 lb., the largest on record, compared with the 1944 record of 298·9 lb. and 267·2 lb. harvested in 1947. The condition of the crop as at August 1, 1948, is given at 85 per cent. compared with 78 per cent. a year ago, and 72 per cent. two years ago.

456. Cotton Variety Affects Cotton Purchases. By F. L. Gerdes. (*Text. Indus.*, 111, **4**, 1947. From *Text. Tech. Digest*, v, **4**, 1948, p. 148.) A review of the principal varieties of cotton grown in the United States and of some of their fibre characteristics. Improvement of fibre quality is also discussed.

457. Louisiana: Cotton Investigations, 1944-45. By D. C. Neal. (*Ann. Rpt. La. Agr. Exp. Sta.*, 1944-45. From *Rev. App. Mycol.*, xxvii, **4**, 1948, p. 176.) In the course of cotton investigations for the U.S. Dept of Agriculture it was reported that some progenies of the Dixie Triumph hybrid resistant to wilt had proved satisfactory in yield and resistance tests carried out during 1944-45, and that some of the strains appeared ready for use in wilt-infected areas. Chemical analyses revealed that soil from an uninfected area was high in available phosphorus, potassium, and calcium with a near-neutral reaction of *p*H 6·9, whereas soil from an adjacent heavily infected area was extremely low in phosphorus, and 50 per cent. lower in potassium and calcium, with a *p*H range 5·2 to 5·7. Isolations from healthy soil, employing the dilution plate method, yielded several *Actinomyces* spp. and one bacterial organism, all of which showed antagonism towards *F. vasinfectum* on agar plates. Infected soil yielded several *A.* spp., none of which showed any pronounced antibiotic activity.

458. New Mexico: New Cotton Variety. (*Rpt. of Chief of Bur. of Pl. Indus. Soils, and Agr. Eng.*, 1945. From *Rev. App. Mycol.*, xxvii, **5**, 1948, p. 224.) Acala 1517 WR, a new cotton variety developed at the New Mexico Cotton Field Station, and resistant to *Verticillium* wilt (*V. alboatrum* and *V. dahliæ*) was selected for release in 1945.

459. Oklahoma: Information for Visitors. By H. A. Daniel *et al.* (*Exp. Sta. Circ. C*-129, Oklahoma Agr. Exp. Sta., May, 1948.) *Crop Rotation.*—At the Red Plains Conservation Experiment Station, Guthrie, a crop rotation of cotton, wheat and sweet clover has reduced soil loss 76 per cent. and run-off water 33 per cent. annually compared to continuous cotton during eighteen years at the Station. Both the wheat and sweet clover greatly reduced erosion, but the amount of soil removed from the wheat plot was 5·9 times more than that from sweet clover. The native grass sod was broken out, and this experiment started on virgin soil

in 1929. The yield of seed cotton in the rotation in the first and second five-year periods was less than that on the continuous area. But during the third period it was 58·5 per cent. higher, and in 1945-47 it increased an average of 174·7 per cent. The yield of seed cotton on the continuous area in the last five-year period was 96 lb. per acre less than in the first five-year period, whereas on the rotation plot it was 170 lb. more. The extent to which any crop rotation is effective in reducing soil and water losses is primarily dependent upon two factors: First, the proportion of close-growing vegetation in the rotation; and second, the length of time and season of the year that this close-growing vegetation occupies the land. Close-growing, cultivated plants that produce protective land cover during the critical soil loss periods are especially valuable in conserving soil and water.

460. TEXAS: COTTON STATISTICS. By C. A. Bonnen and L. P. Gabbard. (*Circ.* 117, Texas Agr. Exp. Sta., 1947.) Includes statistics of acreage, yield per acre, production, estimated losses in yield due to insects, plant diseases, and weather; the amounts of commercial fertilizers used on cotton; percentage of sales of lint by months. Maps and charts are also included showing distribution of acreage, and trends in acreage, production and price.

COTTON IN EGYPT

461. EGYPT: COTTON PROSPECTS, 1948-49. (*Cotton*, M/c., 31/7/48.) Information from the Alexandria Commercial Company is to the effect that the new crop in both Upper and Lower Egypt continues to improve, and it appears certain, unless some unforeseen and major disaster occurs, that there will be a satisfactory crop. Most of the initial delay has been made up, and reports from all centres indicate that flowering and bolling are good and plentiful. Weather conditions are favourable. The leafworm attack has been mild, and the water supply, if not abundant, is at least sufficient to prevent any serious damage.

462. COTTON IN EGYPT. (*Barclays Bank Rev.*, xxiii, **2**, May, 1948.) Following a brief description of the climate, soil, and cultivable area for cotton in Egypt, an account is given of the modern history of cotton cultivation in the country, dating from about 1830, when in the reign of Mohamed Aly, the founder of the present dynasty, the variety, Jumel, was discovered in Cairo by the Swiss-French engineer Jumel. The importance of the Egyptian crop in the world's supply of cotton is stressed. The following matters are also discussed in the article: The formation of the Alexandria Futures Market in about 1861; the Alexandria Cotton Exchange Association in 1883; the work of the classifiers and graders of the Egyptian cotton export houses; the cotton research work carried out by the Cotton Research Board, Giza, where several famous varieties have been evolved and developed; the establishment of a Humidity Testing House to prevent the abuse of over-watering of cotton—a practice which at one time was all too prevalent.

463. EGYPT: COTTON FUTURES MARKET. (*Overseas Rev.*, Barclays Bank Ltd., June, 1948, p. 13.) It is announced in the press that Government has approved in principle the reopening of the Futures Market as from September 1 next; there are to be two contracts, one based on Karnak and the other on Ashmouni. Further details are awaited regarding the numerous changes in the pre-war regulations which, it is believed, will be enacted in order to curb excessive fluctuations and undue speculation.

464. JUMEL COTTON: UTILIZATION. By A. Bruckert. (*L'Indus. Text.*, **64**, 1947, p. 242. From *J. Text. Inst.*, xxxix, **4**, 1948, p. A182.) A historical account of the development of the Jumel variety of Egyptian cotton is followed by a description of its properties, and the procedure generally adopted in spinning, dyeing, weaving and packing. Special practical advice is given on several points, and future prospects are discussed.

465. THE EGYPTIAN COTTON GAZETTE. The contents of Volume 4, May, 1948, include the following: "Egypt and the International Cotton Advisory Committee" (A. M. Allouba Bey); "The Raw Cotton Situation in the United Kingdom" (D.

Windel); "Post-war Developments in the United Kingdom—Progress of Rehabilitation" (D. Windel); "Giza 30—A Variety with a Big Future" (C. H. Brown); "Cotton Seed Oil Industry in Egypt"; "Cotton Seed Cake 'Kusb'" (F. Khalil); "Comparison of Quality of Egyptian and other World Cottons"; "Spinning Tests on the Egyptian Cotton Crop of 1947"; "The Statistical Situation at the 1st May, 1948" (R. Dabbous). Various statistical tables and diagrams are also included.

COTTON IN OTHER FOREIGN COUNTRIES

466. Argentina: Cotton Prospects, 1947-48. (*Cott. and Genl. Econ. Rev.*, 4/6/48.) Heavy frosts around Saenz Pena and the surrounding districts on May 21 rendered it unlikely that there would be any increase in the crops in these areas. Estimates were that the total crop would be around 70,000 metric tons—a production insufficient even for domestic mill requirements.

467. Belgian Congo: Cotton Industry, 1947-48. (*Cott. and Genl. Econ. Rev.*, 16/7/48.) *Northern Region.*—The 1947-48 crop reached 58,871 tons of seed cotton. Lint production amounted to approximately 19,000 tons. Yields would have been considerably better had not the harvesting period been affected by abnormally heavy rains. This excess humidity interfered with the normal development and fruiting of the bolls, and lowered quality to some extent. A substantial amount of lower quality cotton was lost in the field as growers did not think it worth while harvesting, the purchase price having been fixed well below that for better quality. As regards the 1948-49 season, all that can be said at present is that preparation of the land for cotton planting has been subjected to a certain delay due to the fact that growing of rice has received priority, and has been extended.

Southern Region.—Markets opened for purchase of seed cotton in June. The crop was planted at the normal time, and was favoured with regular rainfall, followed by satisfactory cultivation. Later growth, however, was handicapped by reduced rainfall. Insect damage was light, and it is predicted that the production of seed cotton will exceed that of the previous season, which amounted to 59,845 tons, yielding approximately 20,000 tons of lint.

468. Belgian Congo Cotton: Development of Cultivation. By F. Selliez. (*Bull. Comité Coton. Congolais*, **21**, 8, 1948, p. 3. From *Summ. Curr. Lit.*, xxviii, **8**, 1948, p. 187.) The cultivation of cotton was introduced into the Belgian mandatory territory, the Ruanda-Urundi, in 1927. The same decrees governing the cultivation, buying, and trading of cotton which were operative in the Belgian Congo since 1921, were adopted for the Ruanda-Urundi. No compulsion was used; the successes achieved are attributed to the good services of the official agronomists and agents, to the distribution of tools free of charge, the establishment of 19 buying posts at convenient locations, maintenance of stable prices, and the readiness of the natives to accept advice in agricultural matters. The cotton variety, 14-125, which has spread over the whole of the region during 1945 and 1946, combines the qualities of Allen Long Staple with a high yield, high ginning outturn, and good resistance against insect pests. It is expected that the present annual output of 4,000 tons of seed cotton will be exceeded by half in the near future and by more if a variety could be found suitable for the mountainous areas. A soil-conservation mission is at present exploring the possibilities of making suitable for cultivation the vast alluvial plain north of Lake Tanganyika.

469. China: Economic Crisis. (*Cott. and Genl. Econ. Rev.*, 8/7/48.) The economic upheaval precipitated by the collapse of the currency is rapidly assuming catastrophic proportions. The Chinese Government is supposed to have been drawing up plans for a new currency system for some time past, but although the Chinese dollar status is now so low that trading is for the most part transacted on a barter basis, there is still no sign that plans have progressed beyond the blueprint stage, if as far. Nor is any determined effort apparently being made to tackle the country's two other major economic problems, the enormous budgetary deficit and the widespread evasion of the external trade restrictions which is resulting in the bulk of

the foreign exchange proceeds of Chinese exports disappearing into the black market.

470. Post-War Textile Plans. (*The Ambassador*, June, 1948, p. 142.) Textile fibres have always been consumed in large quantities in China—in greater volume, perhaps, than is generally realized. For instance, it has been estimated that of the 700,000,000 lb. of cotton consumed on a non-commercial basis in the world before the war, two-thirds (or 466,000,000 lb.) went in hand-spinning, padding for clothes, mattresses, etc., in China. Even before the war, however, steps were being taken to place textile production in China upon a commercial basis; and since the end of the war this movement has been intensified. Some idea of the progress that has been made is obtainable from the report of the U.K. Trade Mission to China, recently published.

China's first cotton-spinning and weaving mill was set up in 1890. Large-scale developments took place after the first world war, although about four-fifths of the weaving was still done on hand looms. The Sino-Japanese war caused the emphasis to remain on hand-spinning; in 1939-40 only 53 per cent. of the raw cotton used in the country was consumed in mills. The end of the war with Japan brought an immediate problem to the cotton textile industry—that of keeping the mills, which had formerly been under Japanese ownership, in production. The Government decided to set up its own corporation, the China Textile Development Corporation, to take charge of these. At the time of the British Mission's visit the total capacity of the industry was 4,653 million spindles, of which 1,740 million (37 per cent.) were owned by the new Corporation. Total loom capacity is given as 65,000, of which 37,100 were owned by C.T.D.

471. L'Activité de l'I.R.C.T. pendant la Campagne 1946-47. (*Coton et Fibres Trop.*, ii, 4, 1947, p. 129.) A review of the activities of the French Cotton and Exotic Textiles Research Institute (I.R.C.T.) during 1946-47, the first year of its establishment. The various sections deal with the following: The organization of the I.R.C.T. throughout Central Africa; the enrolment of scientific personnel; the development of experimental stations in Africa; the organization of work in the laboratories in Paris; development of the documentation and publication services. A list of the technical staff employed by I.R.C.T. at the end of 1947 is included, and the situation, rainfall, facilities available, and research work in hand at six stations in Africa are described.

472. Japan: Cotton Industry, 1948. (Int. Cott. Adv. Comm., Washington, D.C., August, 1948.) Cotton yarn output continues to increase, but rehabilitation of spinning mills is reported to have slowed down due to scarcities of steel and other materials necessary to the manufacture of replacements, and the target of 4,000,000 installed spindleage has been postponed until the end of 1949.

473. New Trade Agreement. (*Cott. and Genl. Econ. Rev.*, 30/7/48.) Under the terms of a new trade agreement between Japan and the Sterling Area covering overall payments, sales of Japanese cotton textiles to Sterling Area countries can be financed on a 100 per cent. sterling basis, instead of 50 per cent. in sterling and 50 per cent. in U.S. dollars as previously. Any balances of overall payments, however, will have to be made convertible into U.S.A. currency. The agreement will permit a considerable expansion in trade, but only if the exchange of goods and commodities is developed both ways. Since Japan needs to increase her imports of many sterling-area products, while many sterling-area countries require large quantities of textiles and other manufactures, prospects for an overall increase in trade looks reasonably promising.

474. Japanese Textile Trade: Revival. By A. W. Jessup. (*Text. World*, 98, 1948, pp. 101, 182. From *Summ. Curr. Lit.*, xxviii, 7, 1948, p. 184.) The author discusses the future prospects of the Japanese textile industry. Striking figures are presented of annual production, imports, consumption, and exports, from 1930 up to and including 1945. He forecasts that it will be at least 10 years before the industry can fully recover; the present operable machinery is from one-quarter to one-third of pre-war make, and production is tremendously handicapped by the

shortage of coal and other raw materials. Until 1950, at least half the production must be exported to pay for imports. The supply per head of textiles in Japan until then will only be about 2 lb. The whole industry is in the process of re-organization in view of the revolutionary new labour laws passed under the direction of the American authorities.

475. JAPANESE TEXTILE EQUIPMENT: CONDITION. By A. W. Jessup. (*Text. World*, 98, 1948, p. 104. From *Summ. Curr. Lit.*, xxviii, 7, 1948, p. 184.) The Japanese equipment is classified as "good" for cotton, "fair" for wool, and "ancient" for rayon. Some of the cotton equipment and processes are better than in the United States, but winding and warping are poor. High-draft is almost universally used. Rayon machinery dates back to 1935, but modern trends are appearing in machinery manufacture.

476. RUSSIA: COTTON INDUSTRY. (Int. Cott. Adv. Comm., Washington, D.C., August, 1948.) Information concerning the condition of the current cotton crop in the Soviet Union is scanty, but unfavourable weather, pests, and a number of adverse organization factors are reported to have affected prospects unfavourably. Cotton cultivation is stated to be increasing in the Ukraine. Hopes of achieving the five-year plan for textile output in four years were voiced at a recent conference, but in certain districts delays in raw material deliveries and in machinery repairs have held up production.

477. SOVIET COTTON. (*Cotton*, M/c., 6/3/48.) New varieties of cotton are reported to have been developed in which the bolls grow on the stalks, and not on the branches as is usual; this allows the planting of considerably more cotton per hectare.

SOILS, SOIL EROSION AND FERTILIZERS

478. ROTHAMSTED EXPERIMENTAL STATION. The report for the year 1946 has recently been received. A brief review is given by the Director of the work of the Station in connection with field experiments, soils, fertilizers, pests and diseases, insecticides, and the application of statistical methods. Detailed accounts of this work by the heads of the departments concerned are included. The reports on the experimental work carried out on both the Rothamsted and Woburn farms are also included. The Library of the Station is steadily growing and now contains over 30,000 volumes dealing with agriculture and related subjects. During the 1946-47 season 131 papers were published in various scientific journals, and summaries of most of these are included in the report.

479. THE EFFECT OF BENZENE HEXACHLORIDE ON SOIL ORGANISMS. By J. K. Wilson and R. S. Choudhri. (*J. Agr. Res.*, 77, 1, 1948, p. 25.) The effect of benzene hexachloride (Gammexane) on the micro-organic flora of the soil and on a representative of four genera of legumes was ascertained by comparing the presence, growth, and certain physiological processes of these organisms and the growth of plants under conditions where the benzene hexachloride was applied and where it was omitted. The production of ammonia and the total population of *Actinomyces*, bacteria, and fungi were affected very little if any by applications considerably in excess of those commonly employed for the control of wireworms. *Chlorella* and two other algae failed to survive even where small applications were made. An application of the equivalent of 30 p.p.m. of the toxic material in the crude benzene hexachloride was injurious to the legumes. No such toxic effects were noted when tests were made with pure alpha, beta, and epsilon isomers. Effect of these isomers was, however, not determined on legumes. The gamma isomer was slightly toxic to algæ. The delta isomer was highly toxic to algæ and also to several micro-organisms, including *Rhizoctonia solani*, urea-decomposing bacteria, and *Actinomyces nocardia*. Heptachlorocyclohexane was toxic also to several organisms. None of the purified isomers or heptachlorocyclohexane was harmful to *Azotobacter*. The crude form of benzene hexachloride however, was toxic to this organism. The injurious effect of the crude benzene hexachloride is due probably to the gamma and delta isomers, to heptachlorocyclohexane, to some un-

identified or uninvestigated isomer, to a combination of two or more isomers, or to some impurity.

480. BORON AND PLANT LIFE. PT. VI. By R. W. G. Dennis. (*The Fertilizer, Feedg. Stuffs and Farm Supplies Jour.*, August, 1947, and subsequent issues.) In tests conducted from 1941-43 on a silt loam soil of Mississippi, R. Coleman consistently obtained increased yields of cotton and cottonseed after borax manuring. The response was marked on unlimed soils and still more pronounced on limed ones. The first application of 10 lb. borax per acre in 1941 increased cotton yields by 3 per cent., a second 10 lb. given in 1942 increased them 13 per cent., while a third 10 lb. in 1943 on the same plots increased cotton yields by 26 per cent. The increase was due to slightly larger and heavier bolls and to an increased number of bolls ripened. An average of the three years' results showed that, where borax was used, 125 lb. more cottonseed was produced per acre. Borax manuring had no effect on the percentage oil in the seed or on the characteristics of the oil. The Grenada silt loam used in these experiments is heavier than most soils of the state, and it is possible that lighter loams may neither require nor tolerate such heavy borax manuring. In 1942, L. C. Olson reported that in Georgia no consistent increase in cotton yield was obtained from borax manuring on representative Georgia soils of water-soluble boron content between 0·05 and 0·55 p.p.m. In 1945 R. S. Vasudeva stated that borax manuring did not assist in controlling root rot disease of cotton in the Punjab.

481. THE SPECTROGRAPHIC ANALYSIS OF SOILS, PLANTS AND RELATED MATERIALS. By R. L. Mitchell. (*Tech. Comm. No.* 44. Published by the Commonwealth Bureau of Soil Science, Harpenden, England, 1948. Price 12s. 6d.) This Technical Communication is an attempt to review the literature on spectrographic methods of analysis that are relevant to the investigation of soils, plants and related substances such as soil parent materials, fertilizers, and animal products, and to present some details of the methods of analysis which have been worked out over the past twelve years in the Spectrographic Department of the Macaulay Institute for Soil Research, Craigiebuckler, Aberdeen. The headings of the various chapters are as follows: Introduction. The Emission of Spectral Lines. The Photographic Plate and its Measurement. Flame Emission Methods. Arc Methods of Spectrographic Analysis: (i) The Normal Direct Current Arc. (ii) The Cathode Layer Arc. (iii) Interrupted and Alternative Current Arcs. Spark Methods of Spectrographic Analysis. Direct Photometry. Notes on the Determination of Individual Elements. Preparation of Soils, Plants and other Materials. The Application of Spectrographic Methods to the Analysis of Soils, Plants, Fertilizers, and other Biological Materials. A comprehensive bibliography is included extending over 28 pages.

COTTONSEED AND COTTONSEED PRODUCTS

482. COTTONSEED AND COTTONSEED PRODUCTS: THEIR CHEMISTRY AND TECHNOLOGY. Edited by A. E. Bailey. (Interscience Publishers, 215, Fourth Avenue, New York 3, N.Y., 1948. Price $17.50. From *Pl. Phys.*, xxiii, 2, 1948, p. 264.) This publication is the most recent in the publishers' Fats and Oils series of monographs dealing with the chemistry and technology of oils and related substances. The book begins with a historical account of cotton and the cottonseed industry in the United States, followed by a résumé of production and consumption of cottonseed products. Physiologists will find the section on composition and characteristics of particular interest as it collates, in a dependable way, major works on structure and processes of cottonseed, its pigment, oil, and protein components. Four sections on grading and processing cover primarily the technology of cottonseed and its products. Several sections are devoted to the role of cottonseed and its derivatives in human and livestock nutrition, all of which collate the most important recent biochemical developments. Author and subject indices are very complete, thus contributing considerably to the reference value of the book.

PESTS, DISEASES AND INJURIES, AND THEIR CONTROL

483. EXPERIMENTS ON THE PHYSIOLOGICAL ACTION OF CONTACT INSECTICIDES. By D. Dresden and B. J. Krijgsman. (*Bull. Ent. Res.*, 38, 4, 1948, p. 575. From *Rev. App. Ent.*, xxxvi, Ser. A, 6, 1948, p. 174.) The main object of this paper is to show that the powerful action of DDT, the γ-isomer of benzene hexachloride, and rotenone as contact insecticides, and their greater toxicity to insects than to vertebrates when applied externally, is due, not to their having a specific action on the internal tissues of insects, but merely to their being more readily absorbed through the cuticle of insects. The results are given of a number of tests by the authors and others in which the median lethal doses of all three insecticides to insects and a frog (*Rana esculenta*) and of DDT and γ benzene hexachloride to mammals were determined when the poisons were applied on the skin or by intravenous, intra-abdominal or subcutaneous injection.

484. R.B.1018. UN NOUVEL INSECTICIDE. By H. S. Lepage *et al.* (*Coton et Fibr. Trop.*, iii, 1, 1948, p. 3.) Discusses the results of a number of experiments carried out at the Biological Institute, São Paulo, Brazil, on the insecticide properties of a new organic product derived from phosphorus, "R.B.1018." The new insecticide appears to have a marked toxic influence on cotton parasites, while it does not affect the growth of the plant.

485. INSECT PESTS OF COTTON IN INDIA. By H. D. Nangpal. (Redrafted and re-arranged by K. A. Rahman and C. M. Afzal. Ind. Cent. Cott. Comm., 1948. Price Rs. 2.) An account of the cultivation of cotton, the varieties grown, and the pests and diseases which attack the crop in Sind, Punjab, United Provinces, Central India, Central Provinces and Berar, Baroda State, Bombay, Hyderabad State, and Madras. Forty-seven insects attacking cotton are listed, including those which destroy cotton seedlings, cotton leaves, stems and branches, buds and shoots, floral buds and flowers, green bolls, and open bolls and seeds. The following information is given in connection with each pest: Name and systematic position; distribution and status as a cotton pest; nature of damage; brief description of the stages; alternative food plants; life history and seasonal history; general climatic relationships; natural enemies and biological control; direct control measures. A glossary of botanical terms used in the text is also included.

486. BOLL WEEVIL AND COTTON APHID: CONTROL BY CALCIUM ARSENATE AND NICOTINE. By R. C. Gaines *et al.* (*J. Econ. Ent.*, 40, 1947, p. 600. From *Summ. Curr. Lit.*, xxviii, 7, 1948, p. 163.) A report of trials during 1939-46. Nicotine from all sources when mixed at 1-3 per cent. with calcium arsenate controlled boll weevils and cotton aphids. Cotton aphid control with nicotine in a calcium arsenate programme for boll weevil control resulted in a significant yield of seed cotton.

487. BOLL WEEVIL AND COTTON APHIDS: CONTROL. INSECTICIDE TESTS IN 1946. By I. J. Becnel *et al.* (*J. Econ. Ent.*, 40. 1947, p. 508. From *Summ. Curr. Lit.*, xxviii, 7, 1948, p. 163.) Benzene hexachloride containing 2·88-5·17 per cent. of the γ-isomeride was as effective as Ca arsenate or Ca arsenate-1 per cent. nicotine mixture for controlling the boll weevil, and prevented increases of cotton aphids. Ca arsenate and benzene hexachloride are not compatible. Bollworm and red spiders increased after applications of benzene hexachloride containing 5·17 per cent. γ-isomeride; diluting with sulphur prevented increased infestations of red spider. Ca arsenate-1 per cent. nicotine mixture gave higher yields of seed cotton than benzene hexachloride containing 1·44-2·88 per cent. of γ-isomer; however, when bollworm was controlled with DDT, benzene hexachloride containing 5·17 per cent. of γ-isomer gave higher yields. Bollworm increase after benzene hexachloride applications reduced cotton yields.

488. UNUSUAL FEEDING INJURY BY CORN EARWORMS. By M. H. Muma. (*J. Econ. Ent.*, xxxix, 6, 1946, p. 815. From *Rev. App. Ent.*, xxxvi, Ser. A, 5, 1948, p. 157.) In the course of surveys for *Diatræa grandiosella*, Dyar, in south-central Nebraska on October 15 and 16, rather frequent breakage of maize stalks at or just above or below the ear was noticed. Large, blackened, frass-filled cavities were found just above the joints at which the lodging occurred, and larvæ of *Heliothis*

armigera, Hb., were found in about 20 per cent. of the stalks. These were apparently from a late generation, as nearly half of them were only half to two-thirds grown. Estimates of damage in thirty fields in nine counties showed that all had some breakage due to *H. armigera*; three fields had about 5 per cent. of the stalks lodged, but most had 1 per cent. or less. The cause of this unusual type of injury is not definitely known, but it is thought that the prolonging of the maize season well into October, which resulted from a dry spring and a rainy autumn, had led to the production of a late brood of larvæ at a time when the ears were mature and freezing temperatures had killed maize leaves and other cultivated and wild food-plants, so that no other food was available but the late maize stalks, which were still somewhat green.

489. COTTON AND EELWORMS: A CORRECTION. (*Rhod. Agr. J.*, xlv, 1, 1948, p. 1.) In the article "Alternative Green Manure Crops," published in the *Rhod. Agr. J.*, November/December, 1947, and reprinted as Bulletin No. 1422, in the penultimate paragraph cotton is included as one of the field crops susceptible to eelworm. This is not correct as far as Southern Rhodesia is concerned, since although this crop is listed by the U.S. Department of Agriculture as being susceptible, it was found in trials carried out at the Tobacco Research Station, Trelawney, by Jack and confirmed by Mitchell, that the strain of cotton currently grown in the Colony, namely 9L34, is highly resistant to nematode and can be strongly recommended in a rotation with susceptible crops such as tobacco and potatoes.

[*Cf.* Abstract 360, Vol. XXV of this Review.]

490. THE COTTON FLEA HOPPER, *Psallus seriatus*, REUT., IN OKLAHOMA. By C. H. BRETT *et al.* (*Tech. Bull. Okla. Agr. Exp. Sta.*, No. 24, 1946. From *Rev. App. Ent.*, xxxvi, Ser. A, 6, 1948, p. 183.) An account is given of work in Oklahoma in 1936-45 on the bionomics, importance and control of *Psallus seriatus*, Reut., on cotton. This Mirid was found to be most abundant in the south-western part of the State, and there is much local variation in the level of infestation, which is correlated with rainfall, plant succulence, and the occurrence of its wild foodplants in overgrazed pastures, weedy fields, neglected fence rows and waste areas. Two other Mirids, *Reuteroscopus ornatus*, Reut., and *R. sulphureus*, Reut., were observed on cotton in 1937 and 1938, respectively, and in one area the latter was at times more numerous than *P. seriatus*. For 15 pairs of *P. seriatus* reared on *Croton* and Ambrosia, the pre-oviposition and oviposition periods (average figures) were 5·3 and 9·5 days, the number of eggs per female was 21·1, the males and females lived for 10·6 and 14·4 days, respectively, and nymphs matured in 17·4 days. For eight pairs of *R. sulphureus* the pre-oviposition period was 4·6 days, 6·75 eggs were laid per female, males and females lived for 6 and 7 days, respectively, and nymphs matured in 22·2 days. The pre-oviposition period for one pair of *R. ornatus* was 4 days, and 34 eggs were laid in 18 days. *R. sulphureus* caused less shedding of squares of cotton than *P. seriatus*, and *R. ornatus* a very slight amount. In July and August, 1938, *Adelphocoris rapidus*, Say, which is usually considered to be of minor importance, was more abundant on cotton than *P. seriatus* in one locality, and in cage tests it caused considerable shedding. The appearance of abnormally developed plants or blank stalks in the field was not caused by *P. seriatus*. The loss of squares may not affect yield or may even increase it, since the normal reaction of infested plants was to increase in size and vigour and retain a higher percentage of blooms and set bolls. If fewer bolls were produced, these tended to grow larger and heavier. In dusting experiments in 1936 and 1941-44 sulphur alone gave excellent control of the nymphs, but was comparatively ineffective against the adults except when Paris green or calcium arsenate was mixed with it, and control had little or no effect on yield. In 1945, the percentage reductions in adults and nymphs, respectively, were 55 and 96 for 5 per cent. DDT, 92 and 99 for 10 per cent. DDT, 66 and 92 for sulphur, 51 and 69 for 10 per cent. sabadilla, and 30 and 60 for Lethane B-71. The yield was unchanged by 5 per cent. DDT, increased by 10 per cent. DDT, slightly increased by sulphur, and reduced by the other dusts.

491. A BIOLOGICAL STUDY OF *Empoasca flavescens*, FABRICIUS (CICADELLA HOMOPTERA). By S. M. Cadaña and Clare R. Baltazar. (*Philipp. Agr.*, xxxi, 1947.

From *Rev. App. Mycol.*, xxvii, 3, 1948, p. 133.) In the course of this study it was observed that during very rainy weather in the latter half of August and throughout September, 1946, numerous adults and nymphs of the cotton leafhopper, *Empoasca flavescens*, a serious pest of several cultivated crops in the Philippines, were killed by a fungus identified by G. O. Ocfemia as *Cephalosporium* sp. Its pinkish-white growth spread over the insects while they were attached to the leaves, and the organism appears to exert a severe check on their reproductive activities under favourable conditions.

492. DATOS SOBRE LA BIOLOGIA DE LA ORUGA DE LAS CÁPSULES DEL ALGODONERO (*Earias insulana*, BOISDUVAL) EN EL LEVANTE DE ESPAÑA. By S. Planes. (*Bol. Pat. Veg. Ent. Agr.*, 14, Madrid, 1946, p. 69. From *Rev. App. Ent.*, xxxvi, Ser. A, 6, 1948, p. 197.) The increase in the cultivation of cotton in eastern Spain has made necessary a study of the bionomics of *Earias insulana*, Boisd., which has been present since the crop was first introduced in 1944. All stages are briefly described. Females of the earlier generations laid their eggs on the flower-buds or terminal shoots, but as soon as bolls were formed, the eggs were laid on these, usually on the upper part and along the junction of the carpels. The average number of eggs per female was 100-150; the oviposition period lasted 30-40 days, so that there was considerable overlapping of stages. The larvæ entered the bolls and fed on the seeds; they pupated in cocoons attached to the outside of the bolls or to the stalks. No cocoons were observed in the ground, as recorded in other countries. The early generations are not numerous enough to cause much damage, but late cotton was often severely damaged in late September and early October. Infested bolls opened prematurely, and often rotted or withered, and the cotton obtained from them was of poor quality. Early sowing diminished the injury, as the larvæ attacked green bolls rather than ripening ones. A table is given showing times taken to complete the egg, larval and pupal stages at temperatures of about 20°C. (68°F.), corresponding to the months of September and October. There was less information available for higher temperatures, but it was estimated that the egg, larval and pupal stages averaged 3, 15-20 and 7-8 days, respectively, in midsummer as compared with 6, 25 and 15-25 days in late September and October. There are thought to be 4-5 generations in the course of the cotton season.

493. TOXICITY OF LIMEWASH CONTAINING DDT OR "GAMMEXANE" TO MOSQUITOES (*Œdes ægypti*, L.). By J. Hadjinikolau and J. R. Busvine. (*Bull. Ent. Res.*, xxxix, 1, 1948, p. 179.) Limewashes containing DDT or "Gammexane" were tested for insecticidal action on mosquitoes (*Œdes ægypti*) by confining the latter in cages with treated walls and ceilings. Only about 60 per cent. of the total internal surface of the cages was treated, but the mosquitoes were averse to settling on the floor, window, etc., which constituted a large part (28 per cent.) of the untreated area. Limewashes containing 160 mg. DDT per square foot gave a high kill of mosquitoes after two hours' exposure in the cage; and 8 mg. per square foot of the active principle of "Gammexane" gave a high kill with a one-hour exposure. Both treatments remained effective for 6-8 weeks under temperate conditions.

494. INVESTIGACIONES SOBRE EL GENERO *Dysdercus* SERVILLE (HEMIPT. PYRROC.). By M. A. Freiberg. (*Bol. Direcc. Algodon*, 125-126, p. 362. Buenos Aires, 1945. From *Rev. App. Ent.*, xxxvi, Ser. A, 5, 1948, p. 142.) Deals with the bionomics and morphology of all stages of *Dysdercus pallidus*, Blöte, which is stated to be the most widely distributed species of its genus in Argentina. The second part of the paper comprises an account of the bionomics and descriptions of all stages of an unidentified species of *Dysdercus* that was observed in 1943 on cotton in the Territory of Formosa and also in Paraguay; it occurred in association with *D. pallidus*, but was far less numerous. As with the latter species, differences in temperature produced changes in colour and variations in the duration of the life-cycle. In the laboratory, the egg stage and total development were completed in 5 and 24-42 days, respectively, at a mean temperature of 30·5°C. (86·9°F.) and in 14 and 60-100 days at mean temperatures ranging from 17·6 to 26·6°C. (about 64-80°F.); the nymphs

did not develop at mean temperatures of 15°C. (59°F.) and below. Oviposition began 7-14 days after the adults emerged; the eggs were laid among debris in batches of 43-112, at intervals of 2-6 days or sometimes longer. Up to eight such batches were laid by individual females. The maximum total number of eggs deposited by a single female was 675.

495. COTTON THRIPS: CONTROL BY INSECTICIDES. By A. J. Chapman *et al.* (*J. Econ. Ent.*, **40**, 1947, p. 575. From *Summ. Curr. Lit.*, xxviii, **7**, 1948, p. 163.) Field trials were made with a dust containing 50 per cent. of benzene hexachloride (5·75 per cent. γ-isomeride) in calcium sulphate diluted with sulphur (325 mesh) to the desired concentration, and with DDT as a 5 per cent. dust in sulphur and as a spray in a xylene emulsion. Against cotton thrips, benzene hexachloride dust (0·18 per cent. γ-isomeride) gave about the same results as 5 per cent. DDT-sulphur dust when applications were 8 lb. dust per acre. In 5-6 days after treatment, the DDT-dusted plants showed fewer thrips than those dusted with benzene hexachloride.

496. COTTON THIRPS: CONTROL BY INSECTICIDES. By R. K. Fletcher *et al.* (*J. Econ. Ent.*, **40**, 1947, p. 594. From *Summ. Curr. Lit.*, xxviii, **7**, 1948, p. 163.) Field studies were made with various preparations of DDT in dusts and sprays and with benzene hexachloride (2·3 per cent. γ-isomeride), Lethane B-71, and Lethane B-72 against *Frankliniella tritici* on cotton. Although thrips populations were reduced, the percentage of thrips-injured plants was not decreased and the yield of cotton was not increased by the treatments. Applications at weekly intervals were necessary to prevent reinfestation. None of the treatments was profitable.

497. DISEASES OF COTTON IN INDIA. By B. N. Uppal. (*Ind. Cent. Cott. Comm.*, 1948. Price Rs. 2.) The history and distribution, description, ætiology, and control measures (where known) are given for the following diseases of cotton in India: Wilt, root-rot, sore-shin, sclerotium wilt, damping-off, root knot, anthracnose, boll rot, boll shedding, "tirak," internal boll disease, sooty mould, blackarm, red leaf blight, rust, grey mildew, and stenosis.

498. THE RELATION BETWEEN THE SIZE OF PLANT AND THE SPREAD OF SYSTEMIC DISEASES. I. A DISCUSSION OF IDEAL CASES AND A NEW APPROACH TO PROBLEMS OF CONTROL. By J. E. van der Plank. (*Ann. App. Biol.*, xxxiv, **3**, 1947, p. 376. From *Rev. App. Mycol.*, xxvii, **5**, 1948, p. 218.) After defining a systemic plant disease as one which extends through the entire susceptible portion, the author formulates three theorems on the relation between plant size and spread of infection: (1) The spread of an infectious systemic disease increases with the size of the plants, size being appropriately determined and other factors being constant; (2) when a systemic disease enters a crop from some uniform outside source the logarithm of the proportion of healthy plants is directly proportional to the size of the plants, other factors being constant; (3) when a systemic disease spreads within a crop, the rate of infection is proportional to the size of the healthy plants, other factors being constant. In these theorems a disease is taken to be systemic if a single effective transmission produces maximum infection of the plants, the word "plant" including in special circumstances parts of plants. Size (in the first theorem) refers to that portion of the plant which can receive infection. For quantitative relations size is taken to be proportional to the probability that the plant receives infection at any instant from a uniform source in appropriate circumstances. In the special case when disease is introduced into a crop by insects or other vectors, size is taken to be the catchment zone of the plant for the insects, and is usually inversely proportional to the number of plants per unit area. Discussing reduction of size in relation to control the author states that numerical calculations show that control of a systemic disease by reducing size is most difficult when the percentage of infection is high. Reduction of infection is then far from proportional to reduction in size. However, control is possible with high percentages of infection, as when a systemic disease affects plants when they are small, if they are planted thickly, and a large population is maintained until thinning

is required. In the case of systemic diseases attacking mature plants, it is a condition of control that the percentage of disease must be reasonably low. The chief advantage of the method is that it applies simultaneously to all systemic diseases, and when a crop is subject to any of them it gives a measure of insurance against all, each independently of the others. Mathematical considerations apart, the control of systemic disease by reducing size is a step in the same direction as controlling disease by localizing the lesions. If this is not practicable, the next step is to limit the disease as much as possible by reducing the size of the plant.

499. The Carbohydrate Metabolism of Germinating *Phymatotrichum* Sclerotia with Special Reference to Glycogen. By D. R. Ergle. (*Phytopathology*, xxxviii, 2, 1948, p. 142. From *Rev. App. Mycol.*, xxvii, 7, 1948, p. 321.) The course and rate of carbohydrate metabolism of sclerotia from 30- to 60-day-old soil cultures of the cotton root rot fungus *Phymatotrichum omnivorum* growing on sterile, inorganic nutrient for periods of 3, 6, 9 and 12 days, were essentially the same in spite of certain differences in the initial composition of the sclerotia. Germination of 18 gm. each of 30- and 60-day sclerotia resulted in losses of 1·09 and 1·03 gm. dry matter, respectively, and in corresponding reductions of 1·22 and 1·24 gm. carbohydrates. The initial 3-day period was characterized by intense metabolic activity, as reflected in the loss during that time of some half the total amount of carbohydrates used in the 12-day experiment. Germination resulted in substantial net losses of non-reducing sugars, free and bound glycogen, and some hemicellulose (the last-named during the 9- to 12-day period). On the other hand, increases were shown by reducing sugars, mannitol (0- to 9-day period) cellulose, and suberin. The free and bound glycogen reserves of sclerotia were the chief sources of substrata for respiration and synthesis. The former process was responsible for 83 to 89 per cent. of the observed loss in total carbohydrates. Glycogen mobilization was associated with a fairly high level of amylolytic activity, which tended to vary inversely with the total glycogen concentration in the germinating sclerotia.

500. Discovery of *Phymatotrichum* Root Rot in Louisiana. By D. C. Neal. (*Pl. Dis. Rptr.*, xxxi, 11, 1947, p. 416. From *Rev. App. Mycol.*, xxvii, 4, 1948, p. 185.) On August 12, 1947, Dr. M. B. Sturgis found that cotton plants in a field north of Bossier City, Louisiana, were infected by *Phymatotrichum omnivorum*, this being the first record of the disease in the State. An extensive survey revealed the occurrence of the disease in one other locality, the damage being rather severe. In addition to cotton the fungus was also found attacking sweet potatoes at Dixie, and carrots, beans, and turnips at Bossier City.

501. Viruses and Virus Disease of Plants. By M. T. Cook. (*Qrtrly. Rev. Biol.*, xxiii, 2, 1948, p. 151.) Published in the author's seventy-eighth year, this book is a fitting climax to his fifty years as teacher and investigator, with much of the time devoted to the viruses. The reader will not find thorough outlines or discussions of particular viruses and the diseases they cause, but rather a very extensive assembly of facts, based on a bibliography of some 1,400 titles, arranged according to the principles of plant virology, and "intended as a historical review and guide." The book presents a most comprehensive panorama of the development of plant virology from 1576 to 1940 available. The false scents and blunders of early virology are duly recounted. They show the gradual building up of the subject, and in some cases they may prevent students repeating errors of the past. There are occasional section summaries, but the author is "more interested in studying and understanding the works of others than in entering into controversies," and is reluctant to intrude his own viewpoints lest he "prejudice the students in their progress." Particularly valuable are the purely biological chapters that deal with plant reactions to viruses and virus transmission, which together constitute half of the text. Other chapters concern the nature and properties of plant viruses with relatively little emphasis on physical and chemical properties. The very detailed table of contents compensates for a rather limited index. A unique feature is the 6-page chronology of landmarks in plant virus research.

GENERAL BOTANY, BREEDING, ETC.

502. EVOLUTION OF THE GENE. (*Nature*, 24/7/48, p. 136.) Professor A. H. Sturtevant discusses one of the most pressing problems of biology in a recent issue of the *American Scientist* (**34**, 225, 1948). It has been a mystery how new heritable material for the production of new characters originates. When Harland, as the result of his work on cotton, concluded that homology of parts in related species is not correlated with the homology of genes which produce them, another reason was given for disbelief in the value of homology for biological analysis. Sturtevant challenges this view and points out that the polyploid nature of cotton permits the differentiation of two sets of genes in the amphidiploids after their creation. Hence, in one species, one set of genes may control some characters, leaving the other free for differentiation. In a different species the reverse takes place. Sturtevant compares the characters in different species of *Drosophila*, and suggests that two organs are homologous if they are conditioned by homologous genes. This implies degrees of homology, since genes may vary from being identical (being allelomorphic mutants), partly homologous to non-homologous. Homology therefore becomes relational and amenable to mathematical treatment rather than absolute. Sturtevant points out that in a diploid organism all the genes are functional in that the characters they affect are subject to selection. An alteration in any one of them will give rise to a new phenotype. Therefore, these genes cannot be spared for other purposes. If, on the other hand, some genes are carried on duplications, these will be surplus to the requirement of the organism and could vary to wide limits without an immediate effect on the individual or even its progeny. He therefore sees a source for new hereditary material, in the duplications which constantly occur in most, if not all, living organisms.

503. A CASE OF SPONTANEOUS REDUCTION OF CHROMOSOME NUMBER IN SOMATIC TISSUE OF COTTON. By M. S. Brown. (*Amer. J. Bot.*, **34**, 1947, p. 384. From *Circ.* 119, Texas Agr. Exp. Sta., 1948.) A plant containing approximately twice the normal number of chromosomes of Upland cotton was obtained as a result of pollinating a commercial variety of cotton, *Gossypium hirsutum*, with pollen of a garden variety of okra, *Hibiscus esculentus*. The plant was sterile, with overlapping leaf lobes and abortive flowers, but there was no evidence that okra chromosomes had taken part in its development. Despite the high chromosome number, polyploid characteristics were absent, and pairing of chromosomes was unlike that in a polyploid. After several seasons, the chromosome number was reduced in part of a grafted branch to 2N-1, or one less than the normal number. The new growth was more vigorous and more nearly normal, but still sterile. The loss of the extra chromosomes in somatic tissue indicates that, even in the absence of sexual reproduction, unbalanced plant types may eliminate incompatible chromosomes and establish more viable forms.

504. CARBOHYDRATE ACCUMULATION IN THE COTTON PLANT AT LOW MOISTURE LEVELS. By F. M. Eaton and D. R. Ergle. (*Pl. Phys.*, xxiii, 2, 1948, p. 169.) In cotton leaves drought caused an increase in hexose sugars, variable effects on sucrose, and large reductions in starch concentrations. In stems and roots, on the other hand, there were always moderate to large increases in the concentrations of hexoses, sucrose, and starch. On the basis of averages of leaves, stems, and large roots the concentrations for the plant as a whole were doubled by protracted drought. Drought thus appears to depress carbohydrate utilization by the cotton plant to a greater extent than it does photosynthesis. Drought resulted in both plus and minus changes in hemicellulose concentrations in leaves, according to conditions of growth, but caused no significant differences in stem and root tissues. The carbohydrate concentration differentials between leaves and stems were greater in the instance of plants on dry than on moist soils, thus indicating that drought did not interfere with polar transport. In summers with enough rainfall to prevent evident or frequent wilting, irrigation increased growth substantially.

505. OBSERVATIONS ON THE DEVELOPMENT OF THE COTTON BOLL, WITH PARTICULAR REFERENCE TO CHANGES IN SUSCEPTIBILITY TO PESTS AND DISEASES. By R. C.

Rainey. (*Ann. App. Biol.*, xxxv, 1, 1948, p. 64.) Continuous and well-marked changes in composition are demonstrated during the development of the cotton boll, and discussed in relation to this period. Cotton buds and flowers, the main food of the earlier instars of *Heliothis* and *Diparopsis*, and, at the beginning of the season, of *Platyedra*, represent the richest recorded source of nitrogen available to the larvæ. The first two weeks of boll development, when most physiological shedding occurs, are characterized by extremely rapid growth, the dry weight of the ovules being approximately doubled every two days throughout this period. The developing ovules are richest in reducing sugars during the second and third weeks, when moisture-content is also highest. Bolls of this age are attacked by the later instars of *Heliothis* and *Diparopsis*, which are the stages at which the accumulation of larval fat is likely to be most active. Male *Dysdercus*, which can survive for prolonged periods in simple sugar solutions, show a marked preference for bolls of this age, which are punctured to a varying extent by other stages of *Dysdercus*, probably primarily as a source of water. This is also the stage at which attack by *Nematospora* is most damaging; reducing sugars provide a highly suitable source of carbon for this fungus. The cellulose of the mature lint and the oil and protein of the ripe seed are mainly laid down after the boll reaches full size (at 4-5 weeks under local conditions), about half-way through its maturation period, and are largely derived from materials entering the boll in the course of its subsequent development. Premature senescence, such as that associated with *Alternaria* attack, can thus affect yield even when defoliation does not occur until after most of the bolls have attained full size. The ripening seed, becoming steadily richer in oil and protein during the latter part of boll development, forms the main food of *Platyedra* towards the end of the season, a change of diet reported to induce the larval diapause. Ripe seed provides food which is essential for satisfactory nymphal development and probably also for oviposition in *Dysdercus*; specific protein requirements are possibly involved. Examples of direct effects of environmental factors on the development and composition of the boll are described. Over the range of conditions experienced by the experimental material these effects were relatively small.

506. The Effect of Dusting Schedules on the Yield of Cotton. By J. C. Gaines *et al.* (*J. Econ. Ent.*, 40, 1947, p. 113. From *Circ.* 119, Texas Agr. Exp. Sta., 1948.) Protection of cotton fruit early in the season resulted in setting early bolls but failed to produce an increase in the total yield. The loss of about 50 per cent. of the squares during the first 30 days of fruiting did not affect the yield where adequate protection was given the fruit from the ravages of both the boll weevil and bollworm later in the season.

507. Contamination in Seed Crops. III. Relation with Isolation Distance. By A. J. Batemen. (*Heredity*, i, 3, 1947, p. 303.) Insects and air produce pollination by very different means, which can be contrasted as follows:

1. Insects move independently of one another, but the experiments show that they do so in a statistically predictable manner. Air, on the other hand, moves in large masses broken up by turbulence, the effects of which are also predictable; but the movement is modified by variation in wind direction and velocity which is unpredictable. 2. Insects carry pollen systematically from flower to flower of the same species: under normal wind conditions, if the species is evenly dispersed, the pollen is distributed equally in all directions. Air-borne pollen, on the other hand, is distributed down-wind and alights on a stigma without regard to its species. 3. An insect can carry only a limited amount of pollen available for pollination. Consequently the amount of pollen of one variety on an insect can increase only at the expense of other varieties. In the air, on the other hand, the amount is almost unlimitable. The atmospheric concentration of pollen of one variety, therefore, has no direct influence on the concentration of another. Bearing in mind these distinctions, formulæ are derived for the effect of distance on contamination in insect- and wind-pollinated crops. These agree well with the experimental results now described. The formulæ for the two classes of pollination are unex-

pectedly similar; so similar indeed that one can derive a common formula for the two. With this formula one can use the contamination observed at two distances to predict what will be found at a third. The formula also throws some light on the breeding behaviour of natural populations.

508. ANALYSIS OF DATA FROM ALL POSSIBLE RECIPROCAL CROSSES BETWEEN A SET OF PARENTAL LINES. By F. Yates. (*Heredity*, i, 3, 1947, p. 287.) The paper describes the analysis of data obtained in plant breeding work when all possible reciprocal crosses between different lines are made. The cases discussed are: self-sterility, no self-sterility, self-sterility with incompatibility within groups of lines. The last case is illustrated by a numerical example.

509. MÉTHODE GÉNÉRALE D'ÉTUDE DES CARACTÈRES TECHNOLOGIQUES DES FIBRES TEXTILES VÉGÉTALES. By O. Roehrich and N. Roehrich. (*Coton et Fibr. Trop.*, iii, 1, 1948, p. 15). The authors describe a method whereby the dye technique of Goldthwait and co-workers for clearly identifying thick-walled and thin-walled cotton has been modified by the use of cellulose acetate voile for sample bags instead of cotton gauze. By this means errors resulting from the absorption of some of the dye by the cotton material will be avoided.

[*Cf.* Abstract 396, Vol. XXV of this Review.]

510. ÉTUDE COMPARATIVE ENTRE DEUX MÉTHODES DE MÉSURE DES FIBRES DE COTON. By G. Parry. (*Coton et Fibr. Trop.*, iii, 2, 1948, p. 49.) Suggested modifications of the Bailey protractor are shown by means of graphs.

511. THE RELATION BETWEEN THE SIZE OF PLANT AND THE SPREAD OF SYSTEMIC DISEASES. I. A DISCUSSION OF IDEAL CASES AND A NEW APPROACH TO PROBLEMS OF CONTROL. By J. E. van der Plank. See Abstract 498.

FIBRES, YARNS, SPINNING, WEAVING, ETC.

512. COTTON STALKS AS WOOD PULP IN PAPER PRODUCTS. By C. F. Atkins and U. Brooks. (*Bibl. Sci. Ind. Rpts.*, v, 1, 1947. From *Text. Tech. Digest*, v, 4, 1948, p. 148.) The report covers: (1) Four series of tests on methods of preparing paper pulp from the stalks of the cotton plant; (2) test data on papers made from some of the prepared pulps; (3) a study of the effects of pressure of time and of the nature and concentration of chemicals on the yield of pulp from stalks treated with caustic soda and caustic soda and sodium sulphide. The highest wood content is in the lower stem and roots, but the inner bark yields the best quality of fibre. The soda and sulphite methods gave the best yield of pulp. The results show that the cotton stalks can be processed to produce pulp suitable for making useful paper. The bursting strength of the paper compares favourably with that of some commercial papers, but the folding endurance appears to be low. Photomicrographs and drawings of the various woody structures of the cotton stalk are shown. A bibliography is included. The tests were carried out at the Johnson C. Smith University.

513. DYEING COTTON. PROCESSING PROCEDURES FOR MODERN YARN DYEING. By R. W. Joerger, Franklin Process Co. (*Text. Indus.*, 111, 5, 1947, p. 84. From *Text. Tech. Digest*, v, 4, 1948, p. 193.) The two major steps in dyeing cotton yarn with naphthol dyes consist of the alkaline solution of the naphthol being dyed on, and then placing the yarn in a slightly acid solution of the diazotized base, followed by rinsing and soaking. Details of dissolving the dye, use of formaldehyde, coupling solutions, and yarn preparation are discussed.

514. YARN COUNTS. A UNIVERSAL SYSTEM. Textile Institute, 1948. This booklet explains why yarn counts should be expressed in one standard system suitable for both local and international use, and how counting in grams per kilometre offers advantages over all other systems of yarn counting.

515. INSECTS: ACTION ON TEXTILES; EFFECTS, PREVENTION AND REPAIR. By F. Tiana. (*Ingen. Textil.*, 15, 1948, p. 14. From *Summ. Curr. Lit.*, xxviii, 6, 1948, p. 147.) A detailed account is given of the mode of action of insects on protein and cellulosic materials. The repair of damaged fabrics is discussed, and methods of prevention described; special sections are devoted to the I.G. and Geigy insecticides " Eulan " and " Mitin " respectively.

516. Textiles: Mildew and Rot Resistance. By P. B. Marsh. (*Text. Res. J.*, 17, 1947, p. 597. From *Summ. Curr. Lit.*, xxviii, 7, 1948, p. 171.) The author gives a comprehensive review of present knowledge and progress. Topics discussed are: Causes of textile deterioration; effects of microbiological deterioration on properties; methods of diagnosing fibre and textile deterioration; methods of preventing microbiological deterioration; testing fabrics for behaviour towards fungi. There are 142 references to the literature.

517. Cleaning Quality of Raw Cotton as Affected by Physical Properties of Fibres. By M. A. Grimes. (*Bull. No.* 697, Texas Agr. Exp. Sta., 1947.) A report of a study of the effect of fibre properties on the cleaning quality of 84 cottons grown at Lubbock and College Station during three seasons, and harvested by a mechanical stripper. Length, fineness, strength and maturity of the fibres, classer's grade and staple, and waste, were determined. It was found that the fibre property which had the most effect on cleaning was thickness of the cell wall, frequently called maturity. Although long, fine cotton is more difficult to clean than short, coarse cotton, this difference was found to be due to the greater percentage of thin-walled fibres which generally occur in long, fine cotton rather than to the greater length and fineness of the fibres. Cotton has more thin-walled fibres when grown during seasons of heavy rainfall or irrigation than during normal seasons. Wet seasons result in greater plant growth, more trash is harvested with the cotton, and more thin-walled fibres are formed, all of which contribute to the difficulty of cleaning the cotton. The inter-seed fibre drag (resistance fibres offer to seed separation), does not appear to affect the cleaning quality, nor is the cleaning quality affected by the strength of the fibres.

TRADE, PRICES, NEW USES, ETC.

518. World Cotton Situation, 1947-48. (*Qrtrly. Rev.*, Int. Cott. Adv. Comm. Washington, July, 1948.) The estimated world production in 1947-48 at a little over 25 million bales is some 4·5 million bales less than in 1938-39 but 3·5 million bales more than in 1946-47. The available evidence points to a further increase in production in 1948-49. Estimated at 28·7 million bales in 1947-48, world consumption is about 2 million bales less than in 1938-39 and about the same as in 1946-47. Although E.R.P. and various other developments may offset some of the unfavourable factors at present affecting the outlook, a substantial increase in total world consumption in 1948-49 is unlikely. In regard to stocks, it is estimated that the world carryover as at July 31, 1948, will be 14·2 million bales, which is equivalent to about six months' consumption at the 1947-48 rate. This carryover will be 10·8 million bales less than at the corresponding date in 1938, and 3·6 million bales less than at July 31, 1947. While there is reason to believe that production and consumption will move more closely into line in the coming year, it is as yet not possible to forecast whether the gap will be completely closed, and consequently whether world stocks will be higher or lower at July 31, 1949.

THE EVOLUTION OF GOSSYPIUM
AND THE DIFFERENTIATION OF THE CULTIVATED COTTONS

BY

J. B. HUTCHINSON, R. A. SILOW AND S. G. STEPHENS

(Oxford University Press, 1947, 15s. net)

This is the final report of the Genetics Department of the Empire Cotton Growing Corporation's Cotton Research Station in Trinidad. It embodies the results of twenty years of investigation into the origin and development of the cotton plant.

EXCERPTS FROM REVIEWS

Plant Breeding Abstracts, Vol. XVIII, No. 1, Jan. 1948. "One of the most valuable monographs that have appeared in recent years in the fields of genetics, evolutionary theory and practical plant breeding. . . . Of particular value for its discussion of evolutionary theory, especially the problem of evolution of an economic crop plant. . . . Modern genetical theory has been extremely fortunate in the authors who have done most to expound it. 'The Evolution of Gossypium' deserves to take an honoured place among the neo-Darwinian classics."

Geographical Review, Vol. 38, No. 1, 1948.—By G. F. Carter. "It is probable that no other domestic plant is now as well understood, not even maize. The work is a splendid illustration of the value of research conducted without too great concern for immediately applicable results. . . . The results are of great practical and theoretical value for botanists and agronomists, and of revolutionary significance for students of American prehistory."

Empire Cotton Growing Review, Vol. XXIV, No. 4, Oct. 1947.—By G. D. H. Bell. "This book is an outstanding example of the true value of scientific research to a crop of great commercial value. It makes an extremely important contribution to the available knowledge on the cotton plant, and is an example to workers in other crops of a well-designed and carefully executed research scheme."

New Phytologist, Vol. 46, No. 2, Dec. 1947.—By W. B. Turrill. "This important book should have a much wider circle of readers than one composed solely of botanists interested in the cottons. . . . It is self-evident that the experimental and observational facts here recorded for *Gossypium*, and the reasoned explanations suggested as their theoretical background, will have to be taken into account by everyone attempting to synthesize the results and methods of the evolution of plants. . . . The book is a worthy swan song of the Cotton Research Station in Trinidad, and a herald of future research by the Empire Cotton Growing Corporation on the genetics of cotton in Africa."

Soil Science, Vol. 65, No. 2, Feb. 1948. "The unique feature about the research reported in the book is that it was designed to cover the entire genus, including all the wild species. The value of a knowledge of the wild species becomes apparent in connection with the development of new combinations and in the exploitation of variability in fitting cotton to climate and in choosing lint characters to meet the needs of industry."

Indian Cotton Growing Review, Vol. II, No. 2, April 1948.—By V. G. Panse. "The authors have presented a comprehensive picture of the evolutionary progress of *Gossypium* and its present status in bold outline. It will serve as the most advanced landmark on which further research with both scientific and practical ends will be based for some years to come."

THE EMPIRE COTTON GROWING REVIEW

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Printed in Great Britain by Billing and Sons Ltd., Guildford and Esher